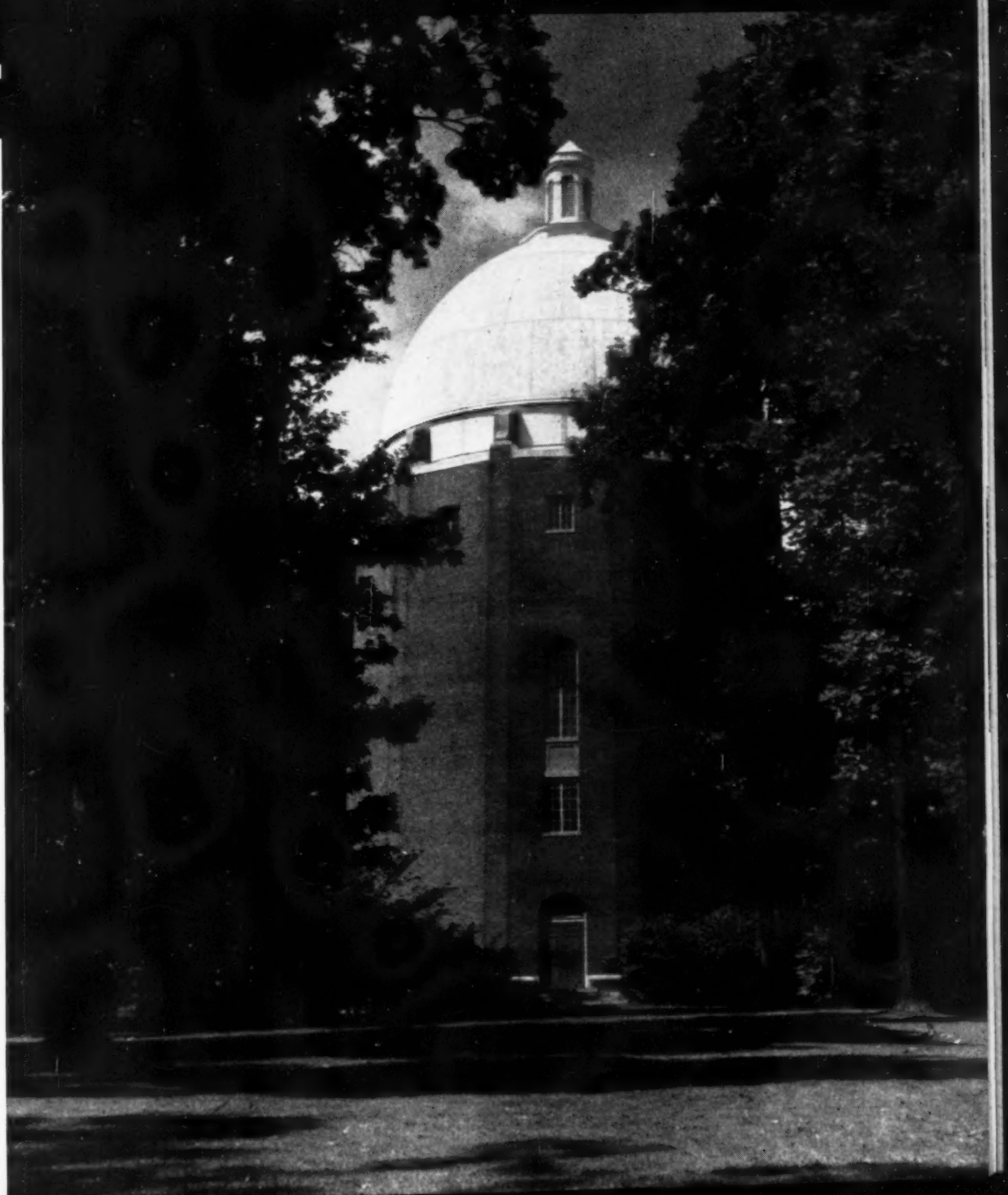
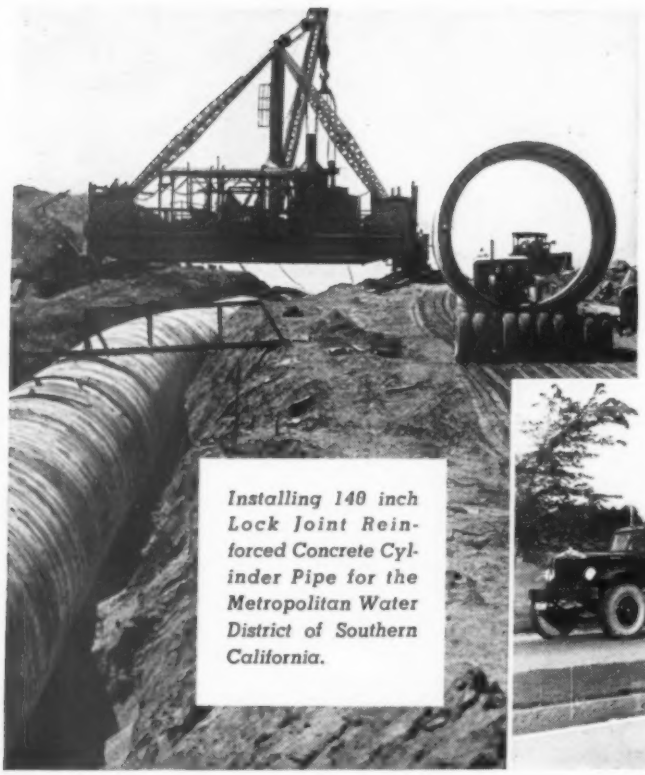
WATER & SEWAGE WORKS



ENTINEL OF STATE COLLEGE

FOR THE *Biggest* JOBS . . .

LOCK JOINT SERVES BEST!



Installing 140 inch Lock Joint Reinforced Concrete Cylinder Pipe for the Metropolitan Water District of Southern California.

Delivery of 138 inch Lock Joint Reinforced Concrete Cylinder Pipe for Boston Aqueduct.

A long record of successful contracts for the manufacture and installation of reinforced concrete pressure pipe in sizes from 16 inches to 150 inches has established Lock Joint Pipe Company as a leader in the field of water supply.

Significantly, Lock Joint Reinforced Concrete Pressure pipe is the first choice of larger municipalities engaged on water supply projects of unusual magnitude.

These are but a few of the major water supply installations built by Lock Joint throughout the past 40 years:

THE CITY OF BOSTON *selected Lock Joint Reinforced Concrete Cylinder Pipe for its 83,000 foot aqueduct. The diameter of the pipe for this huge project ranged from 84 inches to 150 inches.*

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA *chose Lock Joint for 114,000 feet of its water supply system. Lock Joint Reinforced Concrete Cylinder and Bar Cage Pipe ranging from 116 to 144 inches in diameter was used on this project.*

THE CITY OF CLEVELAND *is now engaged in the largest subaqueous pipe installation in history. The Nottingham intake will consist of 120 inch subaqueous pipe running 18,470 feet out into Lake Erie. For this project the City's engineers selected Lock Joint Subaqueous Pipe.*

LOCK JOINT PIPE COMPANY

Est. 1905

P.O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J. • Turner, Kan.

BRANCH OFFICES: Cheyenne, Wyo. • Denver, Colo. • Kansas City, Mo. • Joplin, Mo. • Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. • Kenilworth, N. J. • Hartford, Conn.

SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.

WATER AND SEWAGE WORKS. Reg. U. S. Patent Off. November, 1948. Volume 95. Number 11. Published monthly by Gillette Publishing Co. at 404 North Wesley Ave., Mount Morris, Ill. Per copy, 25c; except *this issue*, 75 cents. Subscription rate: United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as second-class matter March 4, 1948, at the post office at Mount Morris, Illinois, under the Act of March 3, 1879. Executive and business offices, 22 W. Maple St., Chicago 10, Illinois. Editorial office, 155 E. 44th St., New York 17, N. Y.

Precision Engineered for Long, Hard Service

15 Years of Service . . . Over 1700 Installations

THE COMMINUTOR

Is Specifically Designed to Screen and Cut Sewage Solids Under Water

From the Mediterranean to the Philippines; from the Arctic Circle to Australia, wherever there is modern sewage treatment, you will find Comminutors. Such world-wide acceptance is based on a machine that efficiently and effectively performs a service unmatched by any other type of equipment.

The Comminutor, compact, economical, silent, does away with the need for screens, rakes, grinders, burial pits and incinerators or other means of destroying the filth that is obtained by the old methods. With no screenings to stand in the open, there is no odor, no additional labor, and none of the unsightliness usually connected with screenings and their disposal.

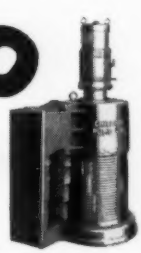
The sturdy construction of the Comminutor is the result of long experience. The drum is a single casting, precision machined to close tolerances. Cutting bars, combs and teeth are firmly seated, yet easily removable for sharpening or replacement. They are staggered and distributed to effect multiple small shearing actions. This, plus inertia of the drum in motion, and gearing, allows use of small motors with consequent power economy. No housing is required for the Comminutor.

The Chicago Pump Company Comminutor is the result of many years of research and trial. "Bugs" in early models have long been eliminated so that the machines in use for many years have established an incomparable record of successful performance in the field.

If you have work in the sewage treatment field, write today for the Comminutor Bulletin which gives complete engineering data.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION



• COMMINUTORS • SWING DIFFUSERS •
• FLUSH-KLEENS • 'PAKAGE' PLANTS •
SCRU-PELLERS • SAMPLERS • NON-CLOG PUMPS

2349 WOLFRAM ST. CHICAGO 18, ILLINOIS

NO BALANCE NEEDED

in controlling tastes and odors with ClO_2

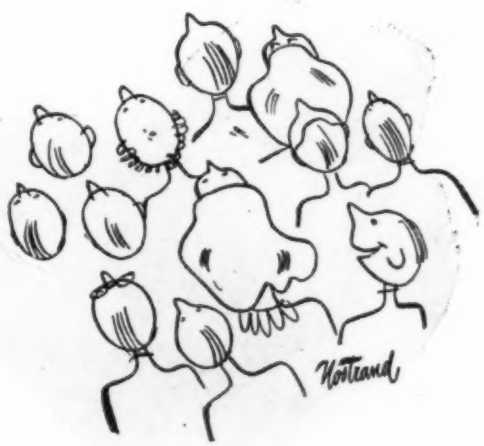
So your water develops tastes and odors during chlorination? And you're always striking a balance between the quantity of chlorine you use for disinfection and the quantity that makes your water unpalatable? Whew!—sounds like a lot of work! Why not use Mathieson Chlorine Dioxide and cut out the balancing?

Simply prechlorinate your water all you wish, then eliminate tastes and odors with Chlorine Dioxide. It's that simple! This powerful oxidizing agent destroys tastes and odors due to algae and other organic matter . . . oxidizes objectionable compounds formed during chlorination. Using Chlorine Dioxide, you'll get residuals to the end of your distribution system. You'll get effective bactericidal action in all types of contaminated water—even highly alkaline and softened water. You'll get disinfection regardless of the character or concentration of organic matter.

The Mathieson Chlorine Dioxide treatment is neither complicated nor expensive. Write for details. Mathieson Chemical Corporation, 60 East 42nd Street, New York 17, N. Y.

Mathieson
CHLORINE DIOXIDE

Chlorine Dioxide...Sanitation HTH...Liquid Chlorine...PH-Plus (Fused Alkali)...Caustic Soda...Soda Ash...Bicarbonate of Soda...Ammonia, Anhydrous & Aqua...Carbonic Gas Dry Ice...Sodium Chlorite Products...Sodium Methylate



WATER & SEWAGE WORKS

WATER SUPPLY—SEWAGE DISPOSAL—INDUSTRIAL WASTE TREATMENT

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

COMING

This Month's Cover Picture

Captioned "The Sentinel of State College, Pa.," this attractive utilitarian structure is the elevated water tank on the campus of Pennsylvania State College.

The tower has been enclosed in the brick structure which serves as a useful storage building while also giving elegance to the "Sentinel" in its dignified setting amongst the trees.

—Photo by Jimmie Symons.

The Water Utility Manager and His Community

Is a short snappy story of some of the things that a water utility manager or superintendent might consider doing in the direction of increasing his stature in his community; and, thereby, gaining recognition for the water utility as well as its management. This suggestive article, written at our request, comes from—

Rotarian ROBERT S. MILLAR, Manager,
Wichita Water Co., Wichita, Kan.

Sludge Lagooning

"Sludge Digestion Practices" have been ably dealt with in a series of articles in previous issues by LEROY W. VAN KLEECK. As an adjunct to many sewage treatment plants, the sludge lagoon has amply proved its worth. In consequence, a knowledge of lagooning practices cannot be discounted. The seventh and concluding article of the Van Kleeck series deals with "Sludge Lagooning" and discusses the construction, maintenance and operation of lagoons.

Color Code Your Plant

Describes the color code employed in painting pipe lines, valves and other equipment in a water plant. The objective is easy and quick identification of the various piping which carry chlorine, ammonia, chemical solutions, etc. The selection of colors and methods of application are discussed in this article, designed to reduce mistakes and increase safety in water and sewage plants. The author—

H. E. LORDLEY, Asst. Chief Engr.
Dept. of Public Utilities, Richmond, Va.

Air Diffusion Problems at Activated Sludge Plants

Are discussed with especial reference to the characteristics of the diffuser plates or tubes and the results of a special study of diffuser clogging, methods of alleviating such clogging and increasing diffuser efficiency. The findings in these studies made at New York City's activated sludge plants are reported by—

L. R. SETTER, Sanitary Chemist,
Formerly of the Dep't. of Pub. Works, N.Y. City.

Treatment of a Highly Colored Water

Is a recounting of experiences in the pre-treatment and filtration of a highly colored water of the Northwest, in which the economic and technical importance of a study of pre-treatment processes has been demonstrated. The authors are—

C. R. HARLOCK, Sup't., and M. R. DOWLIN, Operator,
McNeil Island Filtration Plant, Washington.

A Delayed Report

In this issue is the report of the Pa. Water Works Operators Assn. The report covering the contiguous meeting of the Pa. Sewage and Industrial Wastes Ass'n. proved too long for inclusion in this issue as planned. Rather than depreciate its value by the severe cutting necessary for its inclusion in this issue, it will appear in our next number.

VOL. 95, NO. 11 **CONTENTS** NOVEMBER, 1948

Prestressed Reinforced Concrete Pressure Pipe 379
By M. W. Loving
Glenview, Illinois

Minn. Section's Winnipeg Meeting 385
As reported by A. F. Mellen
Minneapolis, Minnesota

Chart for Determining the Area of Any Ring or Concentric Circle 392
By W. F. Schaphorst, M. E.
Newark, New Jersey

Shall Fluoride Be Added to Public Water Supplies? 393
By Harry A. Faber
New York, New York

67th Annual Convention of N.E.W.W.A. 401

Pollution Load Capacity of Streams 409
By Harold Allen Thomas, Jr.
Harvard University

Penna. Water Works Operators Hold 21st Annual Meeting 414

White Water Treatment and Recovery, Part 4 419
By Willem Rudolfs and A. J. Palladino
Rutgers University

The Bacteriostatic Effect of Methylene Blue on the B.O.D. Test 424
By W. E. Abbott
Nottingham, England

Editorials 426

Meetings Scheduled 87A

"Here and There" with Doc Symons 88A

Manufacturers' and Equipment News 97A

Literature and Catalog Reviews 108A

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(Member—Audit Bureau of Circulation and Associated Business Papers.)

OF ALL THE CAST IRON WATER MAINS EVER LAID IN THESE 25 CITIES SINCE 1817 IN SIZES 6-INCH AND LARGER

Alexandria, Virginia
Babylon, New York
Clinton, Iowa
Clyde, New York
Denver, Colorado
Des Moines, Iowa
Detroit, Michigan
Huntington, West Virginia
Jamaica, New York
Merrick, New York
Norwich, New York
Ottawa, Ontario
Philadelphia, Pennsylvania
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St. Mary's, Pennsylvania
St. Paul, Minnesota
Sag Harbor, New York
Scranton, Pennsylvania
Springfield, Massachusetts
Summit, New Jersey
Syracuse (Suburban), N. Y.
Utica, New York
West Palm Beach, Florida
Winnipeg, Manitoba

Mr. Q-Check says:
Utica, New York, laid its first 6-inch cast iron pipe 99 years ago and 98% of all cast iron pipe of that size ever laid is still in service.

CAST IRON PIPE

96%

ARE STILL IN SERVICE

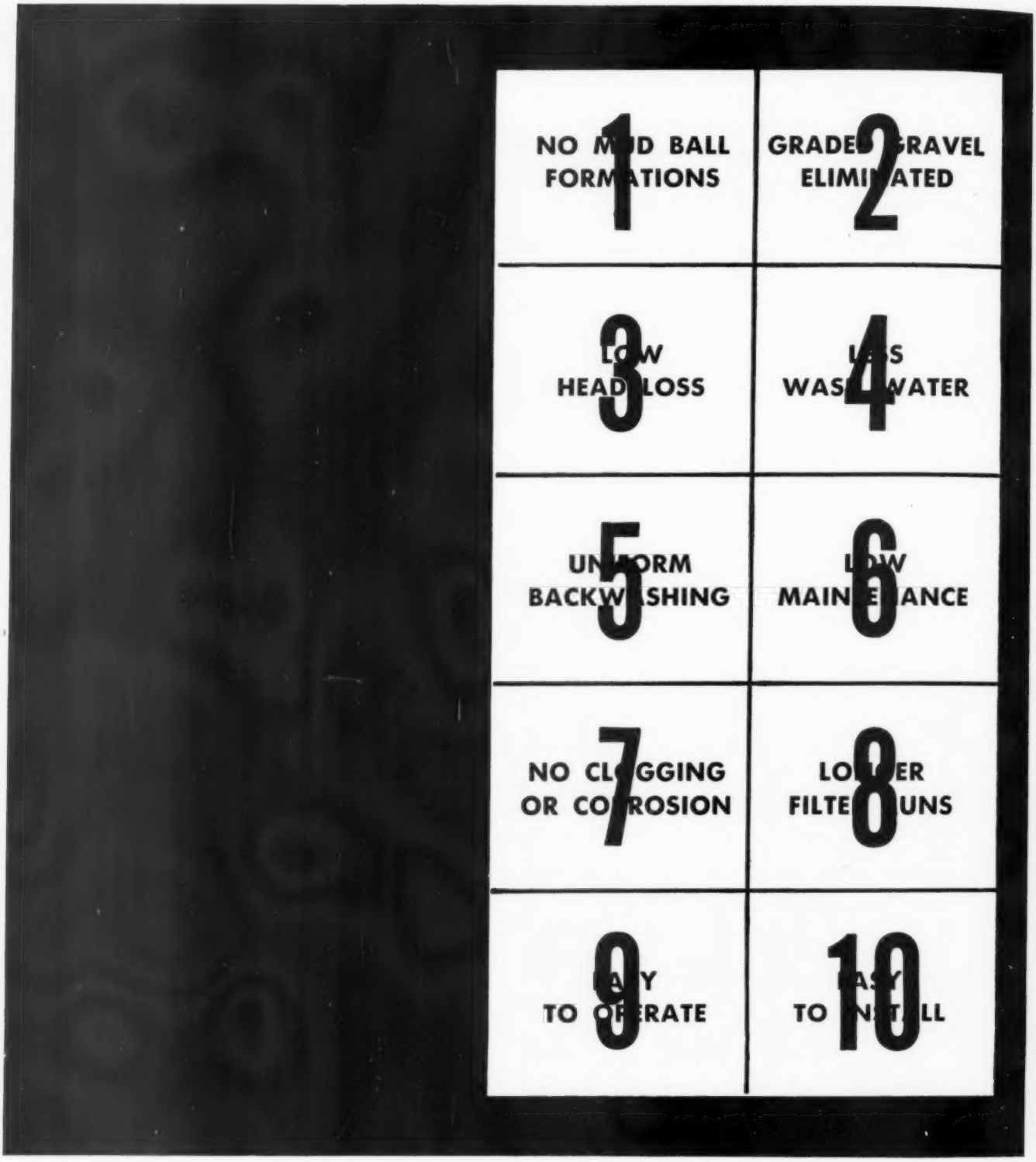
We are stating a fact and you don't have to take our word for it. We refer you to one of the most important fact-finding jobs ever undertaken by the water works industry—the recently completed survey of the service life of water works facilities. This survey was sponsored by three water works associations.

The survey shows that *96%* of all the cast iron water mains ever laid by 25 representative cities in sizes 6-inch and larger *are still in service.*

These cities had laid 50 million feet—nearly 9500 miles—of 6-inch and larger cast iron water mains since 1817. They were selected by the Joint Committee, which directed the survey, as representing a cross-section of water service conditions throughout North America.

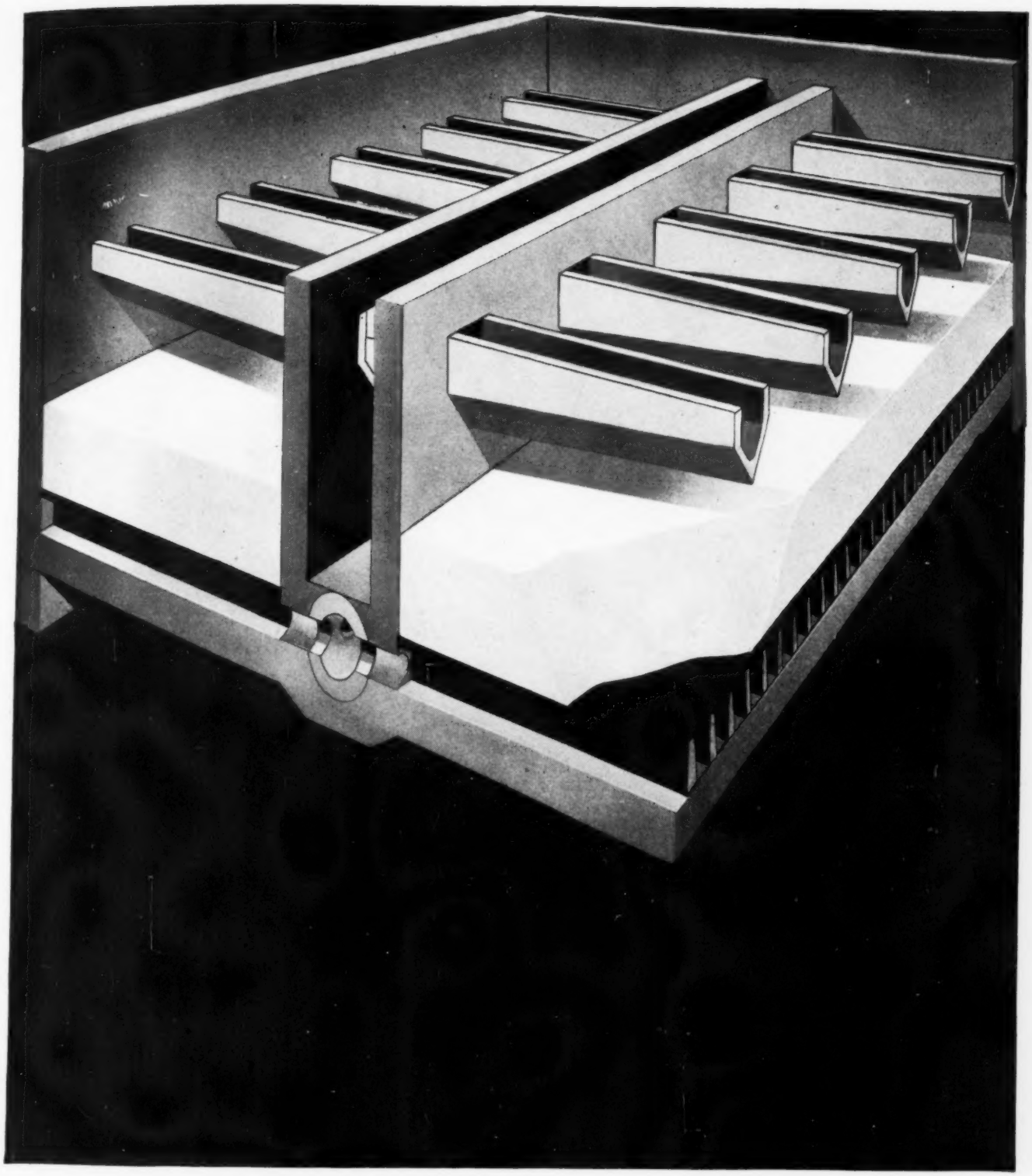
A detailed report of the survey has recently been published by the American Water Works Association. We have reprinted, by permission, the facts pertaining to cast iron water mains in a brochure which will be sent on request. Write to Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 122 South Michigan Ave., Chicago 3, Ill.

SERVES FOR CENTURIES



The elimination of mud balls in this modern water filtration system is accomplished by uniform positive backwashing of every portion of the filter. Graded gravel is not used. There is no possibility of upsetting the filter media. Regrading is never required. Less wash water is used. Maintenance is easier and less costly.

For economy and efficiency, the simple construction and operation of an ALOXITE aluminum oxide underdrain system presents plenty of advantages. They are worth investigating in planning new construction or modernizing. Our technical staff will be glad to supply complete facts. Write Dept. M-118, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



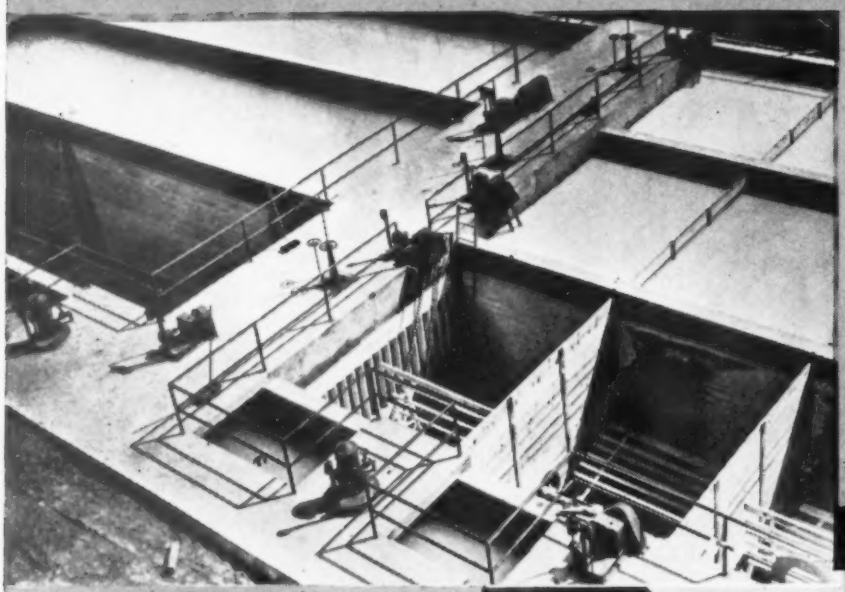
Underdrain Plates

BY **CARBORUNDUM**
TRADE MARK

"Carborundum" and "Aloxite" are registered trademarks which indicate manufacture by The Carborundum Company

CONTROLLED FLOCCULATION

by the Jeffrey FLOCTROL® PROCESS



Left—One of the six FLOCTROLS installed in water softening plant in Rawsonville, Michigan, supplying the Kaiser-Fraser assembly plant.

Below—One of the six settling basins in which the flocculated water is settled prior to filtration.

The Jeffrey FLOCTROL is available in two designs, either of which may be used in water or sewage treatment plants. For most efficient water and sewage treatment consult Jeffrey Sanitary Engineers.

JEFFREY

ESTABLISHED 1877

Jm

5 REASONS *why it pays to stock* Perchloron

REG. U.S. PAT. OFF.

Yes, these sketches illustrate why so many alert engineers maintain a standby supply of Per*chlor*on.

They've found it pays to keep a stock of this handy calcium hypochlorite to help safeguard public water supplies in unforeseen emergencies. Per*chlor*on is stable and uniform. It contains over 70% available chlorine which means that 1 pound of Per*chlor*on is equal to 0.7 pounds of liquid chlorine.

Per*chlor*on is useful in other water treatment functions, too—sanitation of small water systems, new mains, wells, swimming pools. Its properties include the oxidation of ferrous iron in water, removal of hydrogen sulphide, control of most types of algae, and the destruction of chlorine-susceptible bacteria. Write for full descriptive material to Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa.

PENN SALT
CHEMICALS

JACKSONVILLE, FLORIDA

"One of America's Safest Cities"

THE MATHEWS FIREMEN SAY

THAT'S NO IDLE BOAST. Here is one of the Florida cities, accustomed to doing things well, which have the foresight to be Mathews-Hydrant-protected. And wherever there's a Mathews, there's safety plus.

There are Mathews which have been in service for generations; yet they are as sure and troublefree today as the day they were installed. This long life is a result of the design. In a Mathews modernized Hydrant it is impossible for water to reach the operating thread—no rust can form or sand be deposited. A malleable iron shield caps the revolving nut, reducing wrench wear and keeping out rain, dirt and dust. A Mathews drains dry. The main valve is true compression-type. All the working parts are contained in a removable barrel—a little fast work with no excavating, a spare barrel screwed in, and a broken Mathews is back on the job.

For that vital link between the mains and the fire-fighting equipment, choose Mathews modernized Hydrants. Give your community these time-proved guardians with the safety plus.

OTHER MATHEWS FEATURES: Head can be turned 360° • Replaceable head, nozzle outlets easily changed • Nozzle levels raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Operating thread only part to be oiled • A modern barrel makes any Mathews hydrant good as new

MATHEWS HYDRANTS

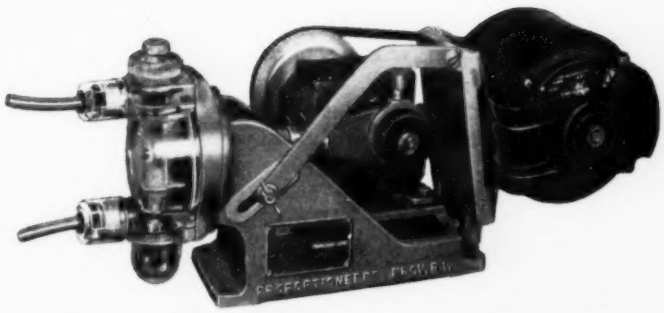
***Made by* R. D. WOOD COMPANY**

Public Ledger Bldg., Independence Square, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

. . . AND IN EVERY COMMUNITY A PURE WATER SUPPLY!

CAMPAIGN promises are rarely kept, but election year . . . and every year . . . you can count on pure, safe water if you choose a %Proportioneers% Heavy Duty Midget Chlor-O-Feeder to hypochlorinate your water supply. This small proportioning pump treats from a few gallons up to a million gallons of water a day, and is easily adjusted to feed any chemical at rates up to 7½ g.p.h., against pressures to 85 p.s.i. When cross-connected to the starting switch of the water pump motor, it provides fully automatic treating in exact proportion to flow. Because of its extremely simple, rugged construction, the Heavy Duty Midget does not require a skilled operator. In thousands of communities where it has been chosen for the important job of making drinking water healthy this "little red pump" has an outstanding record of performance.



Now available from stock — see your local representative or write today for Bulletin HDM-2.

% PROPORTIONEERS, INC. %

9N. CODDING STREET, PROVIDENCE 1, R. I.

Ever Hear of the City

It's Mexico City... Her Dependable Water System Uses A-C Centrifugal Pumps

MEXICO'S CAPITOL CITY *is a place of unique charm with its pleasant mixture of the present with the past. Broad tree lined highways lie side by side with narrow, twisting streets of another era. Lovely old palaces dot the city almost lost amid the rising skyline of modern skyscrapers. It is a blend of the old and the new . . . and the result is a city of never failing wonder to the thousands of annual tourists. Today, it is one of the political and trade centers of the world.*

* * *

Mexico City's water supply is provided by a series of freshwater springs surrounding the world famous Xochimilco gardens. Water is taken from these springs and passed through closed conduits to the Xotepingo pumping station. A 2522

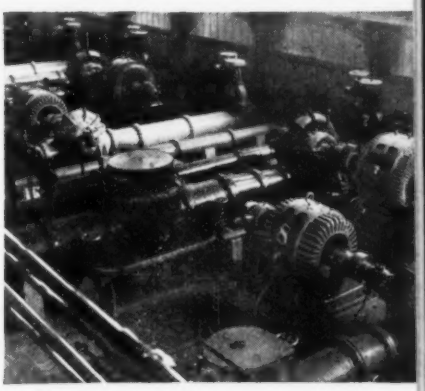
Recently, six new Allis-Chalmers centrifugal pumps have been installed in Xotepingo to handle the increasing residential and industrial demand of the city. These pumps force the water to elevated storage reservoirs and directly into city mains. The combined output of these six new Allis-Chalmers pumps is 107,100 gallons per minute.

Mexico City offers additional evidence of the high regard public works officials hold for A-C equipment. Throughout the world... in large, medium or small cities, the world's widest range of public works equipment is delivering dependable, efficient service. For more information, write for Bulletin 25B6607.

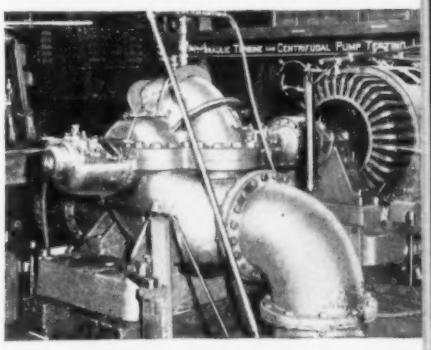
ALLIS-CHALMERS, 1192A SO. 70 ST.
MILWAUKEE, WIS.

Photo, courtesy of Compania Mexicaña Aerofoto, S. A.

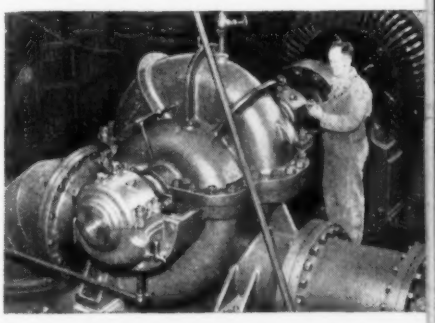
Allis-Chalmers Provides Major Pumping Equipment for Mexico City Station



OVERALL VIEW of Xotepingo Pumping Station, Department of Federal District of Mexico in Mexico City. Combined output of A-C pumps here is 107,100 gpm.



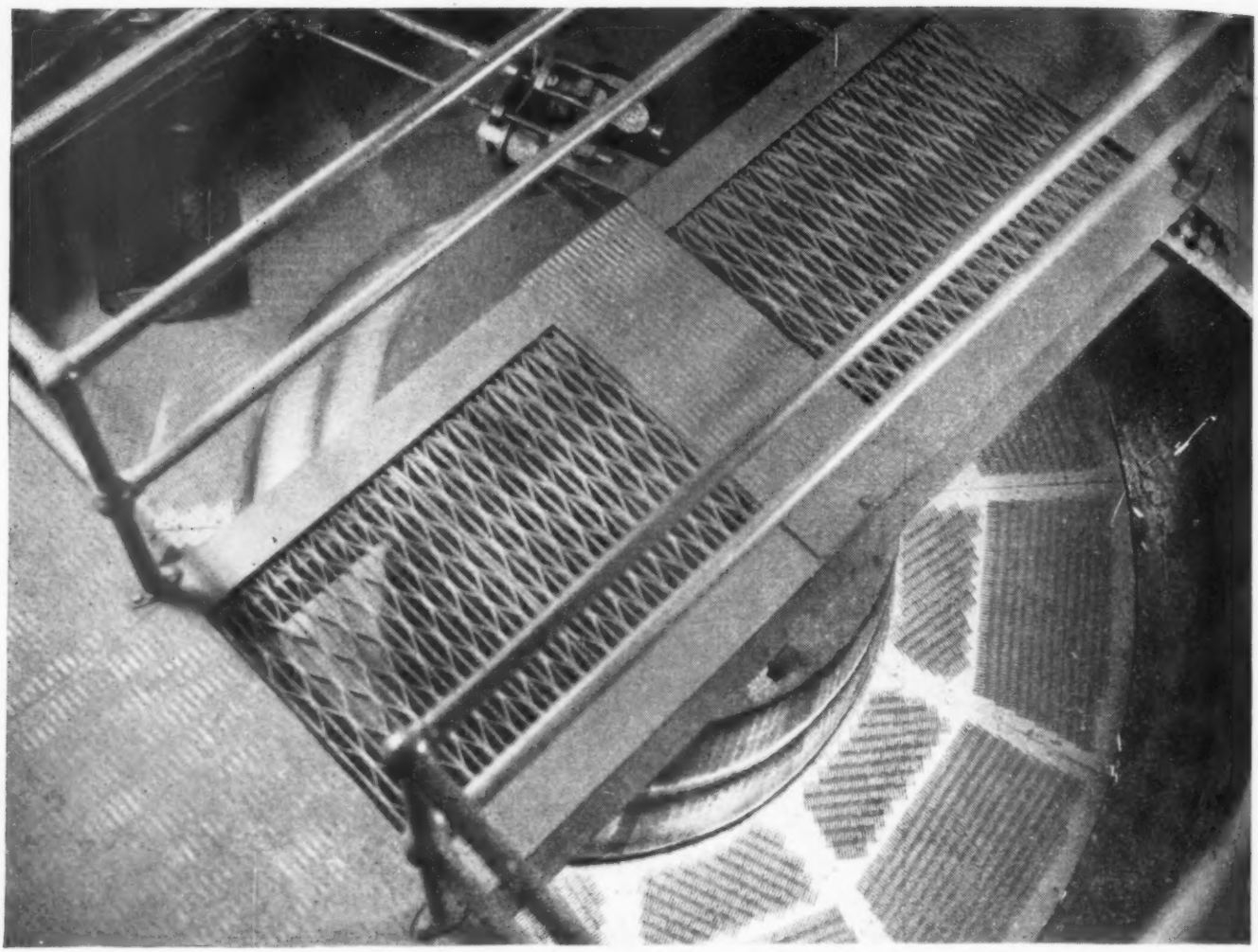
SHOP TESTING a 20 by 18 in. pump for Xotepingo Station. This is one of three similar Allis-Chalmers units, each rated 11,900 gpm, 211 ft. head.



GIANTS of the Xotepingo Station are three centrifugal pumps like this — 30 by 24 in., each with a capacity of 23,800 gpm against a 211 ft. head.

ALLIS-CHALMERS

Builders of the World's Widest Range of Public Works Equipment



EVERDUR SCREENS

in Westchester's Long-range Program

NEW YORK's Westchester County is currently embarked on a long-range sewerage plant modernization and improvement program, under the direction of Mr. J. C. Harding, Commissioner of the county's Department of Public Works.

Involved in this work are extensive replacements for the Blind Brook, Mamaroneck and Yonkers Sewage Treatment Plants. Because of Westchester's favorable experience with Everdur® over a long period of years, these copper-silicon alloys are being specified for many applications. The Everdur screen shown above is one example at Blind Brook (Rye, N. Y.). The milled Everdur plates were fabricated by Hendrick Manufacturing Company, Carbondale, Pa.

And in hundreds of other communities during the past 20 years, extensive use of Everdur Copper-Silicon Alloys in water works and sewerage treatment installations has proved a long-run economy. In every installation the high strength and toughness of these alloys combine with their corrosion resistance to provide outstanding serviceability. Ease of hot or cold working, forging, machining and welding are factors in speedy, economical fabrication.

For more detailed information, write for Publication E-11. 1818

®Reg. U. S. Pat. Off.

ANACONDA
from mine to consumer

Everdur

COPPER-SILICON ALLOYS

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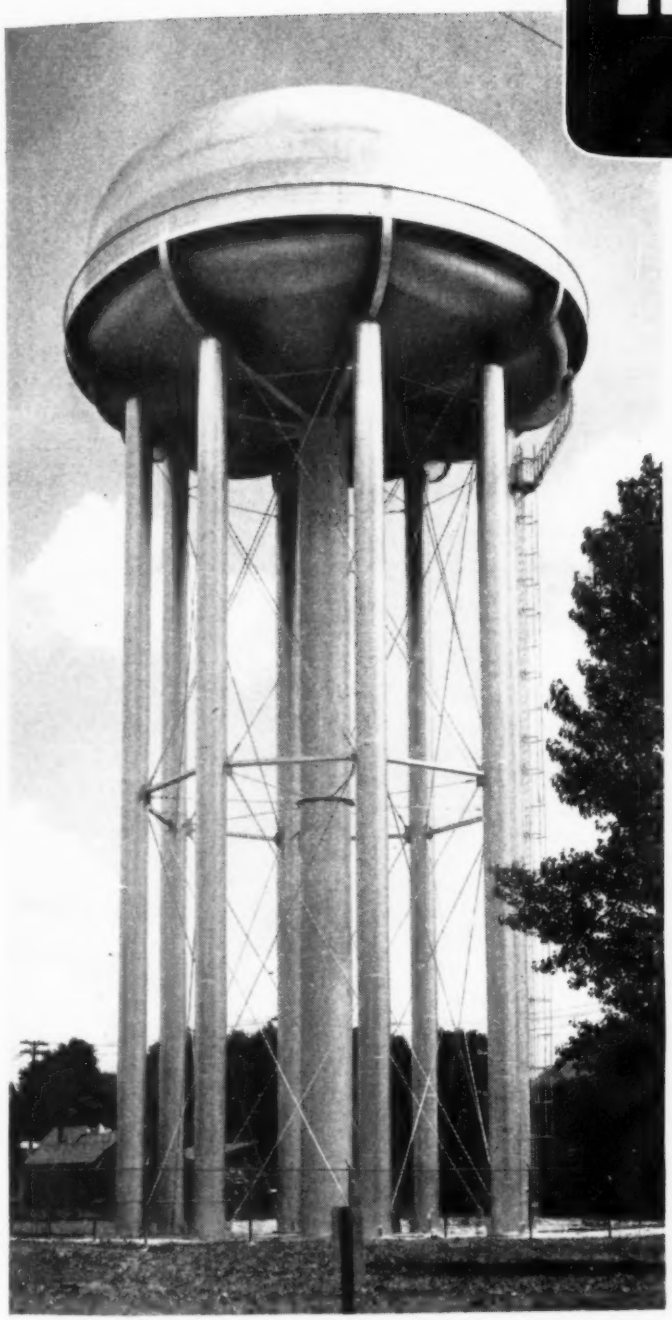
THE NATIONAL GUARD DEFENDS AMERICA—JOIN NOW!

HORTON
Elevated Tanks



**NEW 500,000 GAL.
HORTON TANK
AT BUCYRUS, OHIO**

WELDED CONSTRUCTION
FULL RANGE OF CAPACITIES
FOR MUNICIPAL SYSTEMS

WE recently erected the 500,000-gal. Horton elevated tank shown at the left at Bucyrus, Ohio, where it provides gravity water pressure to supplement pumping pressure throughout the city. The supply of water in elevated storage helps the pumping equipment to meet peak loads by maintaining a uniform pressure in the distribution system at peak load periods.

The new Horton tank at Bucyrus is an example of the radial-cone bottom design which we recommend for tanks having capacities of 500,000 to 2,000,000 gallons. With this design, it is possible to build efficient, large-capacity tanks which do not have excessive ranges in head. Horton ellipsoidal-bottom tanks are recommended for capacities from 5,000 to 500,000 gals. for both industrial and municipal use.

Let us give you estimating figures when your community needs more elevated storage. Send specifications to our nearest office.

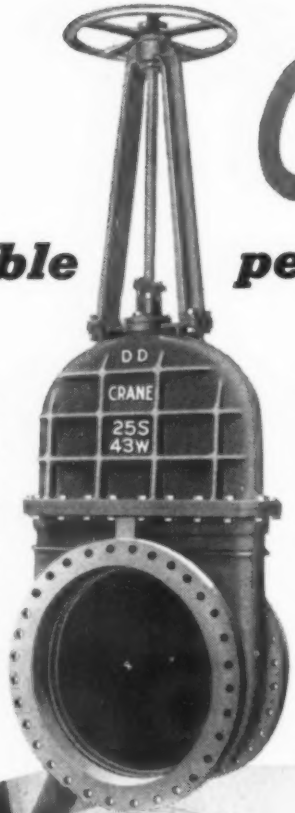
CHICAGO BRIDGE & IRON COMPANY

Atlanta 3.....2181 Healey Building
Birmingham 1.....1586 North Fiftieth Street
Boston 10.....1048-201 Devonshire Street
Chicago 4.....2198 McCormick Building
Cleveland 15.....2262 Guildhall Building
Detroit 26.....1551 Lafayette Building
Houston 2.....2115 National Standard Building
Havana.....402 Abren Building
Los Angeles 14.....1455 Wm. Fox Building
New York 6.....3390-165 Broadway Building
Philadelphia 3.....1644-1700 Walnut Street Building
Salt Lake City 1.....1550 First Security Bank Building
San Francisco 11.....1283-22 Battery Street Building
Seattle 1.....1350 Stuart Building
Tulsa 3.....1646 Hunt Building

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Crane Valves

dependable performers wherever they are



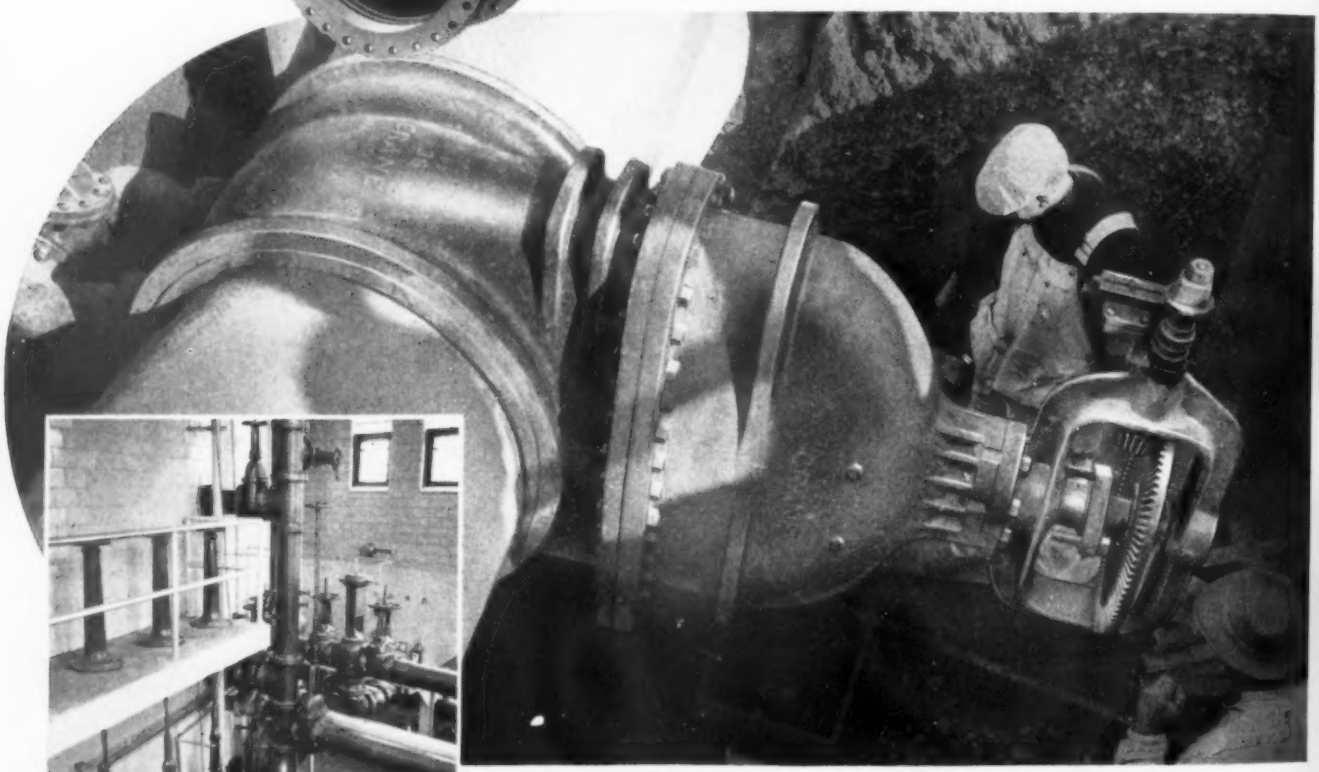
FOR A VARIETY OF SERVICES *not requiring "standard" weight valves—Crane No. 793½ Iron Body Double Disc Gates for low pressure steam, water or gas lines in water works, irrigation, filtration or sewage disposal systems. Short and compact; brass trimmed. Rated at 25 pounds steam and up to 50 pounds cold water, depending on size. Sizes: 10 in. and larger. See your Crane Catalog, p. 122-3.*

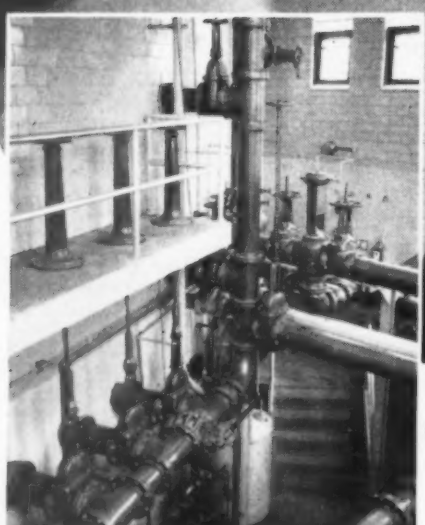
In water works . . . sewage disposal plants . . . irrigation and filtration systems . . . in fact, *wherever* you find flow control equipment, you find Crane valves. Why? Because Crane valves have established a record for dependable performance that is second to none. Today as always, these valves meet the highest standards demanded by the men responsible for the nation's water services.

Crane Quality, in fittings as in valves, minimizes the need for costly repair and replacement—helps keep water utilities functioning at peak efficiency. No wonder so many communities find it pays to rely on Crane for valves.

Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.

Nation-wide Service Through Branches and Wholesalers





SLUDGE CONTROL PIPING *in metropolitan sewage plant, showing Crane low pressure iron body gate valves with extension stems and floor stands.*

CRANE 36-IN. A.W.W.A. *gate valve, with bevel gear and 6-in. by-pass being installed on new supply line from reservoirs into large city.*

VALVES · FITTINGS · PIPE

CRANE

PLUMBING AND HEATING

Long-Term Assets to the Modern Waterworks System . . . . .

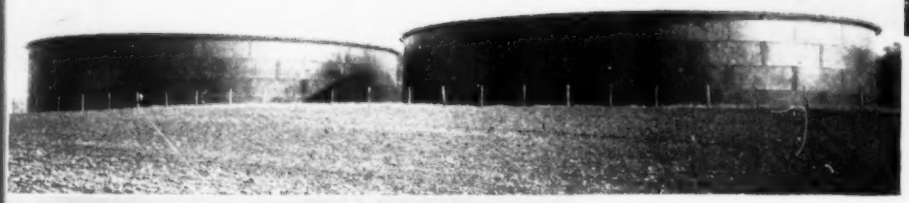
for EFFICIENT SERVICE · LOWER MAINTENANCE · GREATER DURABILITY

Pittsburgh-Des Moines

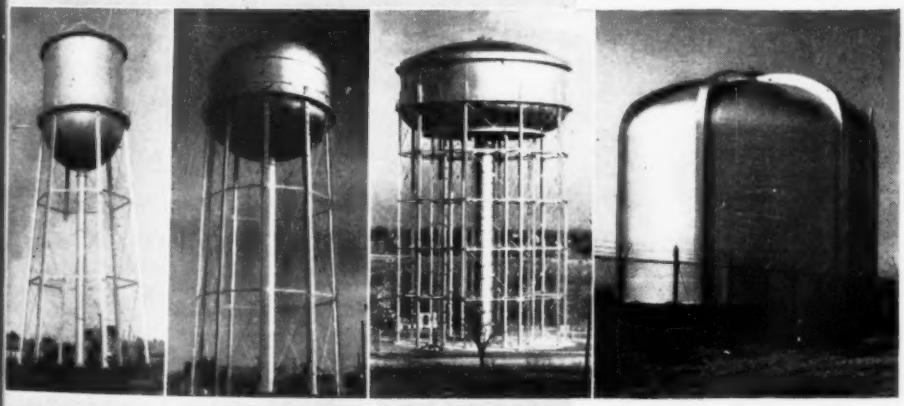
ELEVATED STEEL TANKS

and STEEL RESERVOIRS

1,500,000 gal. toroidal bottom tank; structural tower. Diameter 103'4", head range 25', height to bottom 85'. Fort Dodge, Iowa.



Two 3,000,000 gal. steel reservoirs, diameter 144', height 25'. Berryville, Va.



300,000 gal. cone roof, hemispherical bottom tank, 118' to top. Stillwater, Okla.

500,000 gal. double ellipsoidal tank, on 100' tower. Mission, Texas.

1,000,000 gal. toroidal bottom tank; diameter 76'9", height 127', head range 30'. Keokuk, Iowa.

2,200,000 gal. steel reservoir; ellipsoidal roof; ornamental pilasters. Diameter 80', height 51'. Midland, Tex.

The choice of elevated steel tank or steel reservoir depends largely upon local land elevations. The choice of PITTSBURGH-DES MOINES as designers, fabricators and erectors of your required units is equally logical: you benefit by a half-century of experience in this type of construction, and a guarantee of complete satisfaction with each installation. *May we consult on your water storage needs?*

A NEW PITTSBURGH · DES MOINES STEEL FABRICATING PLANT at SANTA CLARA, CALIFORNIA

PITTSBURGH · DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH.....3418 Neville Island
NEW YORK.....Room 918, 270 Broadway
CHICAGO.....1222 First National Bank Building
DES MOINES.....919 Tuttle Street
DALLAS.....1223 Praetorian Building
SEATTLE.....526 First Avenue, South

THE

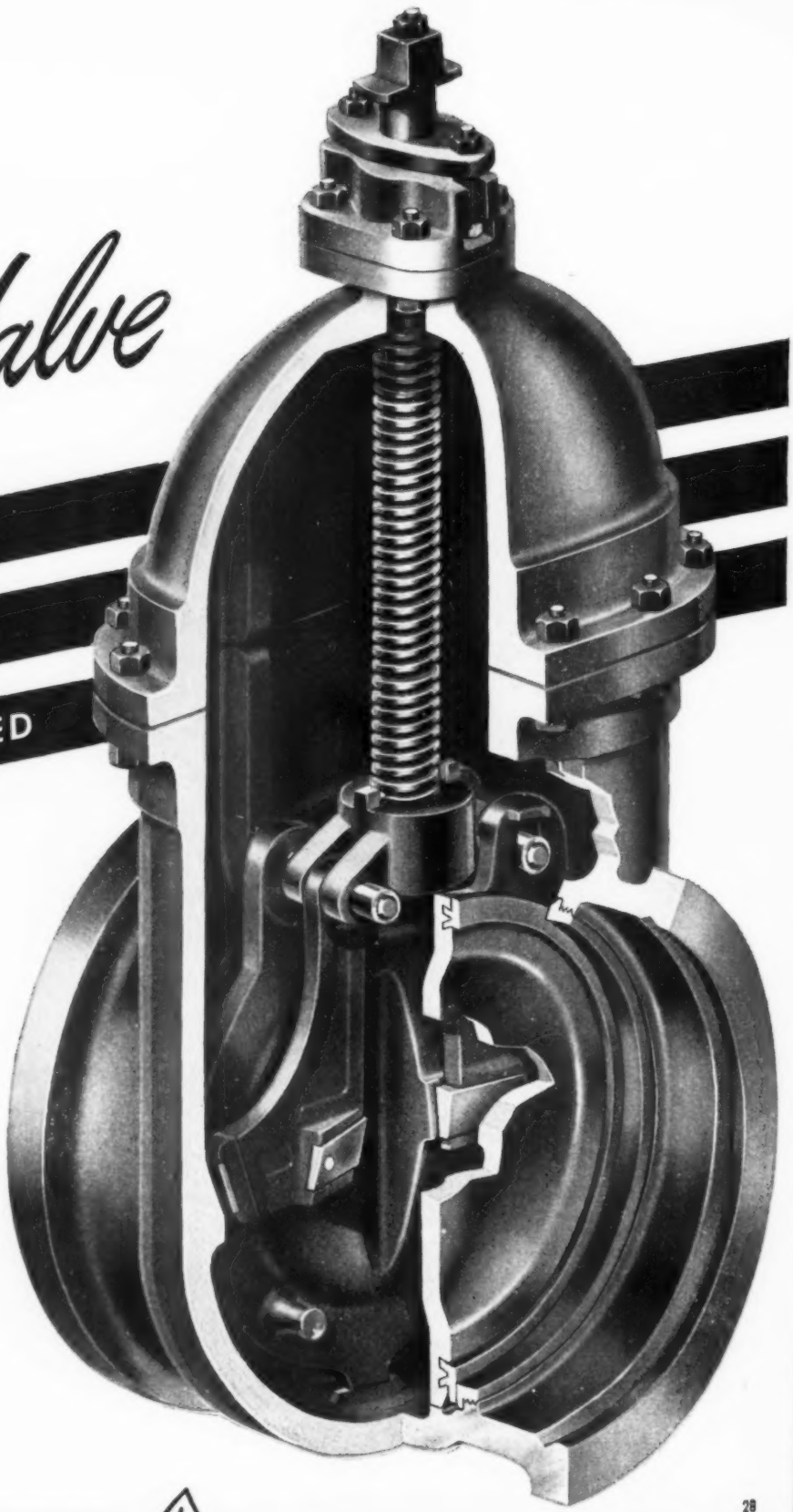
SMITH

Gate Valve

MANUAL,

ELECTRIC OR

CYLINDER OPERATED



The unique side wedging action employed in the Smith Gate Valve positively prevents premature lateral expansion of the discs and consequent binding and scoring of the seats while the valve is being operated.

28

GATE VALVES
CHECK VALVES
FIRE HYDRANTS
INSERTING VALVES
TAPPING SLEEVES AND VALVES
WATER SERVICE BRASS GOODS

THE A. P. SMITH MFG. CO.

ESTABLISHED 1896

EAST ORANGE, NEW JERSEY

FLOOR STANDS
INDICATOR POSTS
TAPPING MACHINES
INSERTING MACHINES
PIPE CUTTING MACHINES
CORPORATION TAPPING MACHINES

DOES LIMBURGER HAVE "Taste" OR "Odor"?

There has been considerable controversy over whether a substance has 'taste' or 'odor', or both. Some psychologists and physiologists claim that there are only four fundamental tastes: salty, sweet, bitter and sour. They maintain that all other so-called 'tastes' are in reality 'odors', and affect only the sense of smell. Water works operators who use Aqua Nuchar Activated Carbon don't have to debate whether water has 'taste' or 'odor'. They know that by using Aqua Nuchar, unwanted tastes and odors are removed by *ad*sorption. Nuchar's action is purely *physical*, so that odors are actually taken out of the water, rather than changed by chemical reaction.

When unpleasant tastes and odors in the water supply reach the consumer, he reaches for his phone to complain to the water department. In more than 1200 communities Aqua Nuchar Activated Carbon has been used to eliminate customer kicks by removing the odorous substances from the water.

Aqua Nuchar stocks are available in key cities throughout the United States. Write today for your data file on purification through *ad*sorption.

industrial CHEMICAL SALES

division west virginia pulp and paper company

NEW YORK CENTRAL BLDG.
230 PARK AVENUE
NEW YORK 17, N. Y.

PURE OIL BLDG
35 E. WACKER DRIVE
CHICAGO 1, ILLINOIS

PUBLIC LEDGER BLDG.
INDEPENDENCE SQUARE
PHILADELPHIA 6, PA.

LEADER BLDG.
526 SUPERIOR AVE., N.W.
CLEVELAND 14, OHIO

OTHER PRODUCTS: Snow Top Precipitated Calcium Carbonate • Nuchar Activated Carbons • Liqro Crude Tall Oil • Tallene Tall Oil Pitch • Indusoil Distilled Tall Oil • Tallex Abietic Acid • Sulfate Wood Turpentine • Alpha Pinene • Beta Pinene • Polycel Cellulose Fibers • Indulin (Lignin)

CONCRETE PIPE

...the Economy "Champ" for Waterlines

Yes, concrete pipe for waterlines is the champion—any way you look at it. Its first cost is moderate, it lasts a lifetime and its annual cost for upkeep is mighty low. Taken together all these add up to ***low-annual-cost*** waterlines.

Concrete pipe has the structural strength to resist the strain of continuous heavy-duty service. It sustains heavy overburdens; its tight joints and uniformly dense structure prevent leakage. There is no tuberculation and far less incrustation in concrete pipe waterlines to impair their hydraulic capacity; taste, odor and dirty water conditions are minimized.

In the construction of the concrete water main in Kansas City, Mo., shown above, more than 7 miles of large diameter concrete water pipe was used. Samuel Kraus, of St. Louis, was the contractor.

Whether you are planning a large water line like this Kansas City project or a small, local community or industrial job—specify concrete pipe for long life and ***low-annual-cost*** service.

PORTLAND CEMENT ASSOCIATION

DEPT. 11-29 • 33 WEST GRAND AVENUE • CHICAGO 10, ILLINOIS

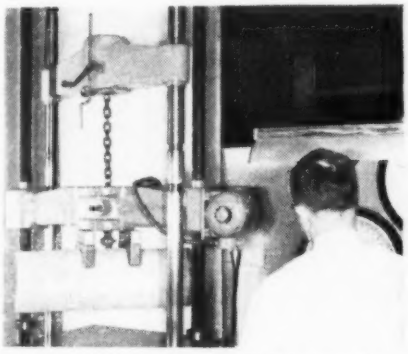
A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

Engineering Facts about

Johns-Manville TRANSITE PRESSURE PIPE

Tapping for Service Connections

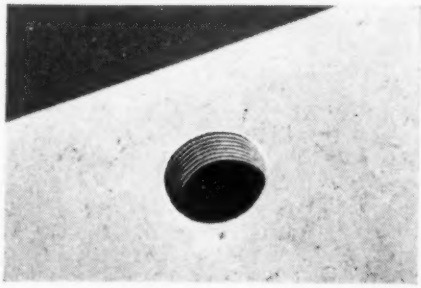
One of the many practical features of Transite* Pressure Pipe is the ease with which it may be tapped for service connections. Proof of this is evident in the hundreds of thousands of corporation stops which, over the years, have been inserted in Transite water mains. Year after year, these installations continue to serve their communities with efficiency and economy.



Laboratory tests demonstrate the strength of service connections made in Transite Pressure Pipe. In a recent series of such tests made on 8" Class 150 pipe, it required an average force of 4360 pounds to pull a ¾" corporation stop from the pipe.

Transite Pipe can be tapped wet or dry; standard tapping machines are used. The special asbestos-cement composition which gives Transite its toughness and durability also provides excellent threading properties. The threads are sharp, clean and strong. Service connections are tight and lasting.

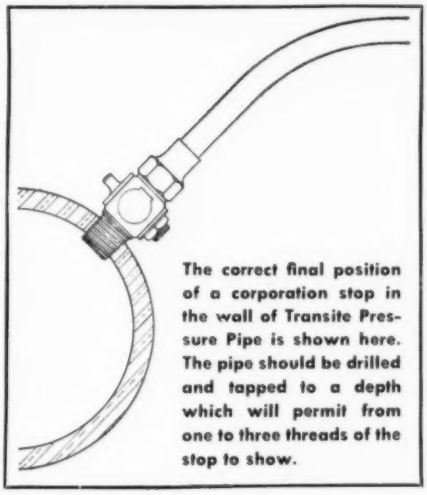
To facilitate tapping and insertion of the corporation stop, the use of a lubricant such as graphite and oil on the tap and the threads of the stop is recommended.



As this photograph shows, Transite Pipe takes clean, sharp threads. Strong and firm, these provide perfect seating for the threads of the corporation stop, assuring a watertight service connection.

Taps may be made with either Corporation Stop threads or Iron Pipe threads. While the standard combined drills and taps may be used, special alloy ones have been developed and are available from leading manufacturers. Field experience shows that these special drills and taps remain sharp after prolonged use and are more economical than standard tools.

As is true with any tapped connection, maximum strength is obtained by engaging the greatest possible number of threads of the corporation stop in the pipe wall. With Transite Pipe, this means that after the pipe wall has been properly drilled and tapped and the corporation stop fully inserted, from one to three threads of the stop will show.



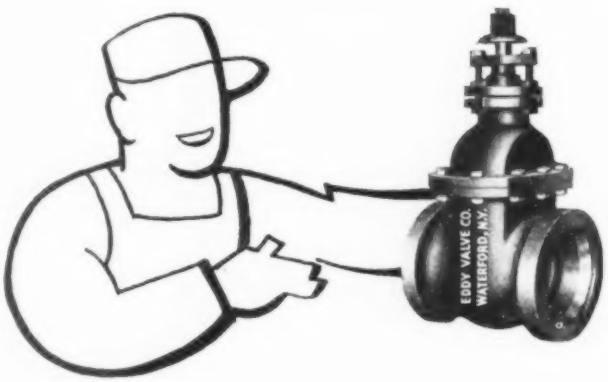
The correct final position of a corporation stop in the wall of Transite Pressure Pipe is shown here. The pipe should be drilled and tapped to a depth which will permit from one to three threads of the stop to show.

Transite Pressure Pipe is readily tapped with standard tapping equipment. Here the combination drill and tap is about to be inserted in the tapping machine.

Additional engineering data relating to service connections will appear in a future advertisement in this series. For further information, address Johns-Manville, Box 290, New York 16, N. Y.

*Reg. U. S. Pat. Off.

JOHNS-MANVILLE JM PRODUCTS



THIS EDDY TAPER SEAT VALVE . . . .

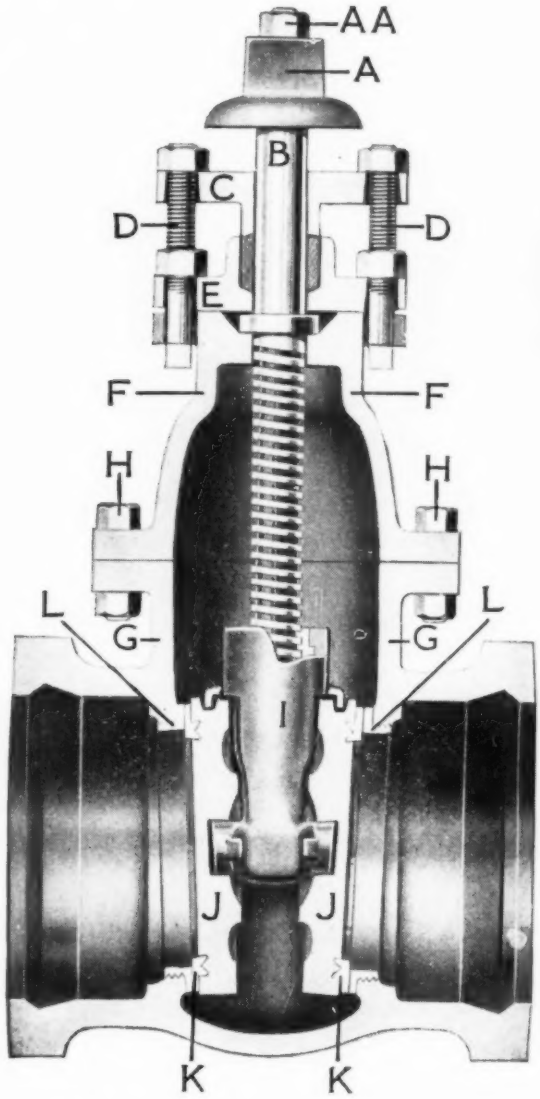
Has Only 3 Moving Parts!

The two Gates and the Ball are the only three parts that are moved by the stem in the Eddy Taper Seat Double Gate Valve. For simplicity, easy, sure operation, durability, high-quality workmanship and performance, the Eddy Valve ranks second to none.

For 99 years the Eddy Valve Company has successfully met the exacting requirements of discriminating buyers of valves. When you buy Eddy, you have the best.

"Eddy for Long Service"

Write today for completely descriptive literature.



AA Stem Hold-down Nut
A Stem Operating Nut
B Stem
C Follower
D Follower Bolts
E Stuffing Box
F Cover
G Body
H Body and Cover Bolts
I Ball
J Gate
K Gate Ring
L Seat Ring

EDDY VALVE COMPANY

Waterford, New York

(Subsidiary of James B. Clow & Sons)

Eddy For Long Service

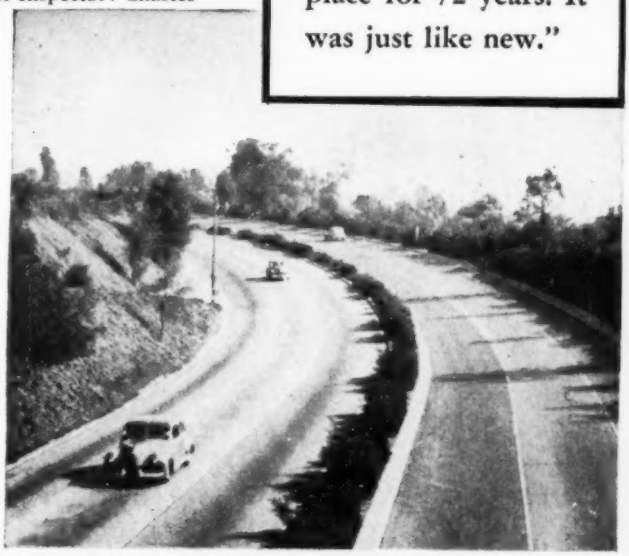
Pasadena SPECIFIES CLAY

More than two miles of Vitrified Clay Pipe, ranging from 18 inches to 36 inches in diameter were used for the Raymond Avenue Outfall Sewer, City of Pasadena, California. It reaches from Garfield Avenue and Arroyo Seco Parkway to the city limits of South Pasadena. City Engineer: John H. Allin. Chief Inspector: Charles Schultz. Contractors: Bebek & Brkich, Los Angeles.

Contractor Nick Bebek of Los Angeles says: "There's nothing like Clay Pipe for sewers. It's the very best. Clay Pipe lasts forever. Why, on one job in Los Angeles I dug up Vitrified Clay Pipe that had been in place for 72 years. It was just like new."

MUNICIPAL officials of Pasadena, California *insisted* on Vitrified Clay Pipe for their new Raymond Avenue Outfall Sewer, because they knew that Clay Pipe is the *only* pipe which resists the deteriorating action of sewage.

In addition to being non-corrosive, this new outfall line had to carry extra-heavy earth and traffic loads. Trenching at one place crossed a ravine of the Arroyo Seco, which was formerly used as a city dump. Through several layers of ancient refuse, 70 feet of cradling was necessary. At another spot the trenching skirted the base of a rocky hill. Fifty feet of trench had to be finished with a pneumatic drill through the rock formation. At still another spot, trenching passed under the six-lane Arroyo Seco Speedway.



The Arroyo Seco six-lane speedway. A 150-foot vitrified clay outfall sewer passes beneath this paving.

Engineers specified Extra-Strength Clay Pipe where necessary to withstand severe loading and Standard Strength Clay Pipe for the rest of the line.

For information on your clay pipe problem, write the details to the nearest office.

NATIONAL CLAY PIPE MANUFACTURERS, INC.

100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
522 First National Bank Building, Atlanta 3, Ga.
1105 Huntington Bank Building, Columbus 15, Ohio
703 Ninth and Hill Building, Los Angeles 15, California

Vitrified

CLAY PIPE

CLAY PIPE NEVER WEARS OUT!

C-248-4

DIXIE TANK AND BRIDGE CO.

3523 LAMAR AVE.—P. O. BOX 14, MEMPHIS 1, TENNESSEE

THE SILENT WATCHMAN

REPRESENTATIVES IN THE FOLLOWING CITIES:

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GREENVILLE, S. C. Box No. 1074
TAMPA, FLORIDA Box No. 1642
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FARGO, N. D. Box No. 1472
COLUMBIA, S. C. Box No. 472
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MACON, GEORGIA Box No. 402
PROVIDENCE, R. I. Box No. 202

Complete Service for Elevated Water Tanks—

30 Years Experience

BE SAFE DON'T GAMBLE!

KEEP THE SAFETY FACTOR IN YOUR TANK THE DIXIE WAY

By welding seams, pits and rivets which gives a riveted tank 15% more Safety Factor than it had when built. No rivets removed, water supply maintained while work is in progress.

On completely re-conditioned jobs, the painting is guaranteed for five years, repairs guaranteed for ten years, provided the tank is painted every five years. Yearly inspection, making all adjustments, if any, without additional cost.

Write Us for Free Copy of Publication

SOUND PRINCIPLES OF WATER TANK MAINTENANCE and TANK TALK, by W. A. RILEY

—SAFETY—SERVICE—SATISFACTION—

COPYRIGHT, 1947

THE LARGEST ORGANIZATION OF ITS KIND GIVING SAFE MAINTENANCE AT LOW COST

Announcing.....

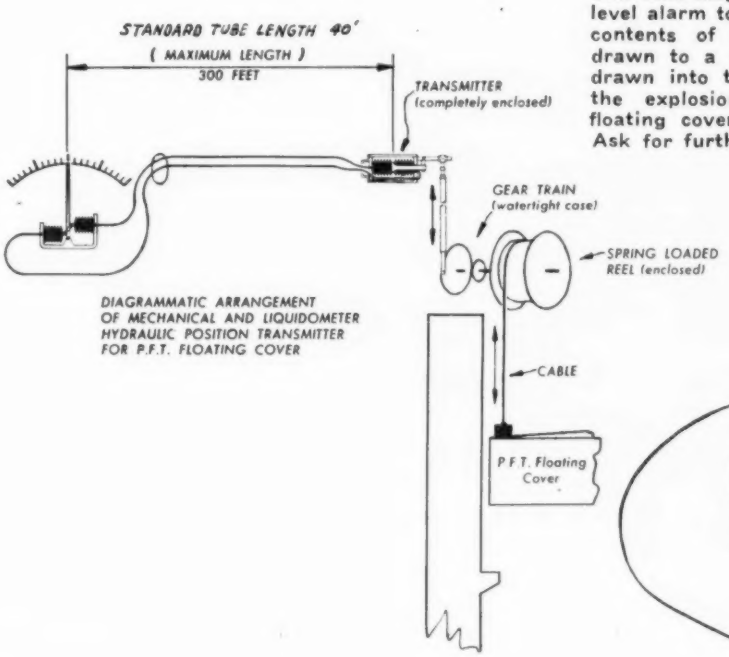
The P.F.T. FLOATING COVER POSITION INDICATOR & LIQUID LEVEL GAUGE

Another sewage treatment plant problem has been solved by P. F. T. engineers. Cognizant of the importance of balancing additions to the digester of raw solids with withdrawals of digester liquor and digested solids, a means of checking the position of the floating cover, from within the digester control or pump room, has long been needed. In developing a unit to fit this definite need, P. F. T. has availed itself of the years of experience of the Liquidometer Corp., Long Island City, New York, in building equipment of a similar nature. Cooperation of both companies made possible this highly efficient floating cover position indicator.

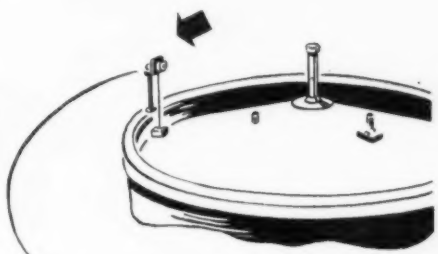
In operation a spring loaded cable reel is mounted on a pedestal at the top of the tank wall (see arrow). A weight suspended on a stainless steel cable rests on the floating cover. As the cover moves up or down the weight rises or falls with it. Through a gear train actuated by the reel or drum, a hydraulic transmitter effects movement of the pointer on the gauge, which can be located anywhere in the pump room or digester control chamber. Indicator is highly sensitive to the slightest motion of the floating cover. Entire unit is simple, trouble-free, moisture and corrosion resistant.

The indicator is provided with a large 12" dial which is easily observed. The unit may be supplied with a low level alarm to give warning before the contents of the digester are withdrawn to a point where air may be drawn into the tank, thus adding to the explosion free operation of a floating cover.

Ask for further details.



DIAGRAMMATIC ARRANGEMENT OF MECHANICAL AND LIQUIDOMETER HYDRAULIC POSITION TRANSMITTER FOR P.F.T. FLOATING COVER



P.F.T.

PACIFIC FLUSH TANK CO.

SEWAGE TREATMENT EQUIPMENT EXCLUSIVELY SINCE 1893

4241 RAVENSWOOD AVENUE CHICAGO 13, ILLINOIS

NEW YORK ● LOS ANGELES ● SAN FRANCISCO ● CHARLOTTE, N. C. ● DENVER ● TORONTO

SURFACE WASH — AUTOMATIC BACKWASH FILTERS — ACTIVATED ALUM -- ZEOLITE
BLACKALUM — KWIK-WAY MIXER FLOCULATORS — FILTER SAND
AUTOMATIC SLUDGE REMOVAL — FILTER BOTTOMS
WATERMAIN CLEANING AND LINI
CARBON -
-- SAND
-- VALVES -- AMMONIA
ALUM -- OVER-HEAD
SULFATE OF ALUMINA -- AER

WHAT'S NEW
in WATER WORKS

details this adv. STUART CORPORATION 516 N. Charles St Baltimore, Md.

FILTERING WATER CONTINUOUSLY

A 10 million gallon water plant at Lock Haven, Pa., filters water continuously using the Hardinge Automatic Back Wash Filter. The secret of this filter is that it washes a 10 in. section across the filter bed at a time instead of taking the whole filter out of service.

There is no loss of head gauges—no operating tables—no 4-way valves—no rate of flow controllers.

Write for literature

CORNELL UNIVERSITY SELECTS KWIK-WAY MIXER FLOCCULATOR

The new addition to the Cornell University Filter Plant (Ithaca, N.Y.) has an overhead drive Kwik-Way Mixer Flocculator, with all of its under water parts made of Everdur Metal. This unit is the walking beam type developed by Stuart Corporation and has no bearings, chains, sprockets, or moving parts of any kind under the water's surface, similar to the Norfolk, Virginia, and Suffolk, Virginia installations.

Write for details

MORE CITIES ADOPT SURFACE WASH

In the past few months, the Cities of Hagerstown, Annapolis, and Frederick, Md.; Miami, Fl.; Lancaster, Pa.; Portsmouth, Va.; and Burlington, N.C., have all adopted the rotary Surface Wash System of Stuart Corporation (The Palmer Filter Bed Agitator). Surface Wash offers many advantages for more economical operation and for better tasting water because the filter sand is really cleaned. Stuart Corporation makes complete installations of Surface Wash Systems.

Write for details—
No obligation

ACTIVATED ALUM INCREASES ALUMINA CONTENT

The new type Activated Alum has more than 18 per cent water soluble Alumina, making it the most powerful water works coagulant available. If you have not tried Activated Alum, order some today. It costs no more and the filter plant will operate better.

Write for details—
Free literature

RUBBER FLIGHT CONVEYORS

A new conveyor, which contains rubber flights, was introduced to the field during war time. It operates on a chain, running inside of a standard 4" or 6" pipe. It will follow bent pipe anywhere—will operate in more than one plane. In other words, it will go up from one room to another and then go upstairs and then return to its original starting position. Designed for carrying abrasive materials including sand—effective for keeping dry-feed machines continuously filled; also for removing sludge; also for grid chambers; also for handling coal.

Write for details

WATER WORKS ASSOCIATION MEETS IN CHICAGO

Annual Convention of the American Water Works Association meets in Chicago on May 30-June 3.

Don't forget to make reservations now.

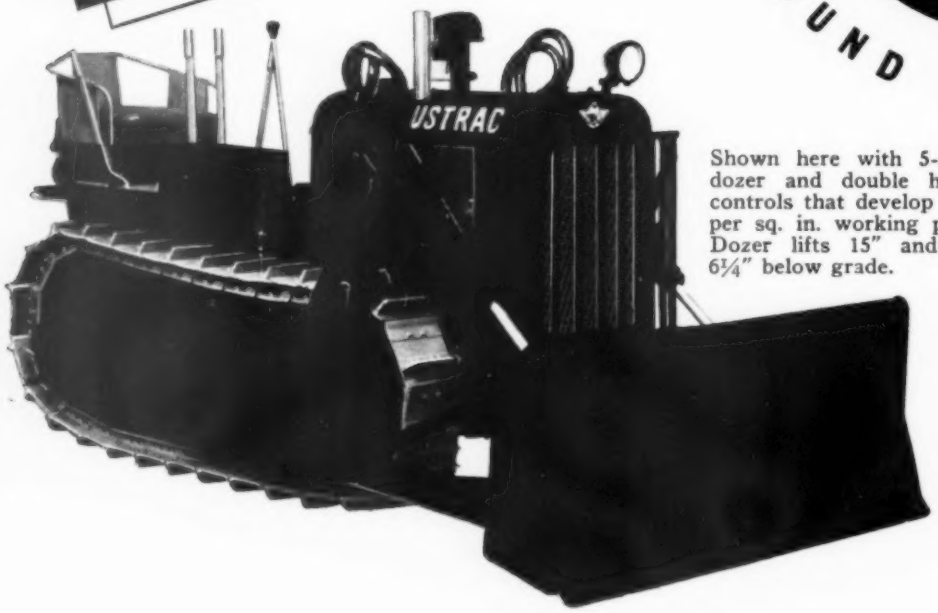
Painted for U. S. Pipe & Foundry Co. by Paul Laune

U.S. PIPE

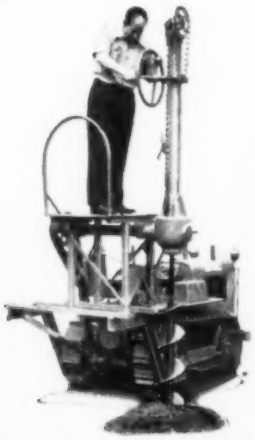
Improvements in the quality, and quality-controls, of U. S. Cast Iron Pipe are the fruits of research and development. They are also the rewards of patience. Months of pilot plant operation may elapse before a process-development is adopted as standard manufacturing procedure. Exhaustive tests in our headquarters research laboratory, one of the finest foundry laboratories, must precede a "go-ahead" to our plants. This is just another reason why you can lay U. S. Cast Iron Pipe with confidence. **United States Pipe and Foundry Co., General Offices: Burlington, New Jersey. Plants and Sales Offices Throughout U.S.A.**

The NEW Crawler with Postwar Features

AROUND THE WORLD



Shown here with 5-ft. bulldozer and double hydraulic controls that develop 800 lbs. per sq. in. working pressure. Dozer lifts 15" and lowers 6¼" below grade.



USTRAC "Speedigger" post hole digger. Easy to attach. Digs all size holes to desired depths. Thousands of "Speedigers" in use — fully proved.

Extra Power and Performance for Your Money

USTRAC is the direct descendant of the famous wartime Clark Airborne Tractor, designed and tested for heavy-duty peace-time work — small but atom-packed with power, 20 h.p. at the drawbar from the 4-cylinder Continental gas engine. Unmatched fast performance — 4 speeds forward, 4 reverse; speeds from .98 m.p.h. to 8.03, with instant reverse lever (no reverse gears to shift), a work-wonder on backfilling and dozing. Only 37" wide, 92" long, USTRAC turns on a dime, gets in and out of narrow places that block a big tractor, is moved swiftly from job to job on any truck. Besides, it cuts fuel costs as much as 50% on many jobs. You simply can't beat the USTRAC for getting a lot of work done fast, easily and at low costs. See your nearest dealer now — or write at once for full information.

Heavy-duty power winch — shown here winching a log 32 inches in diameter. 3-ton pulling capacity — cable-drum holds 325 ft. of ⅜" cable.

Handy Attachments for 100 Jobs

Hydraulic Power Control

Hydraulic Angle Dozer	5-ft. Bulldozer
3-Ton Power Winch	Belt Pully Winch

Post Hole Digger

Pull Type Grader	2-Wheel Terracer

Snow Plow

2-Wheel Wood Box "Low-Boy" Trailer

U. S. Tractor Corporation

WARREN, OHIO, U. S. A.

Badger meters do well in their home town, too!

Milwaukee Water Works (in Badger Meters' "home town") answered a southern City Commissioner's inquiry this way:

"Badger Meters have proved very satisfactory in every respect of design, construction, and capability of registration over a long period."

Milwaukee has many thousands of Badger Meters in use, ranging from ⅝" to 12" sizes, in Disc, Compound, and Turbine types.

In more than 5,000 communities, waterworks men know "It pays to BUY BADGER."

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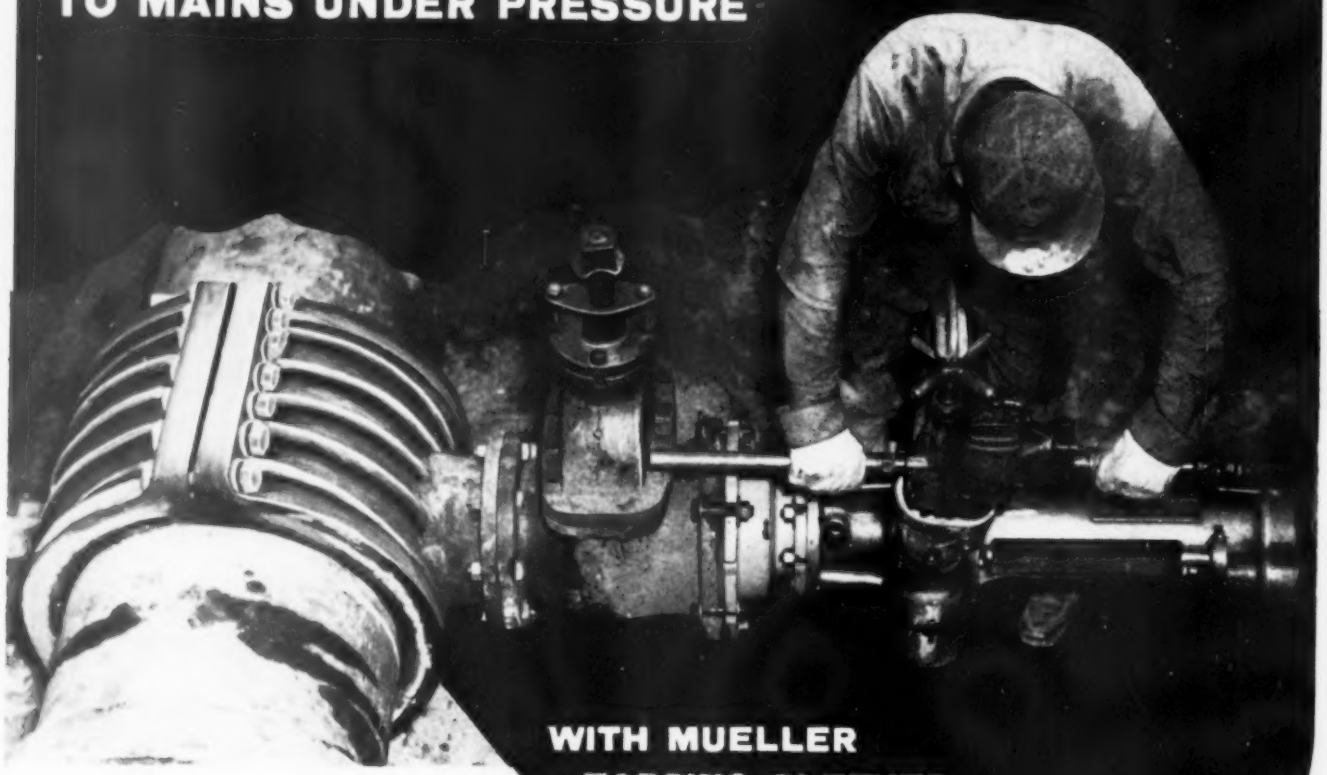

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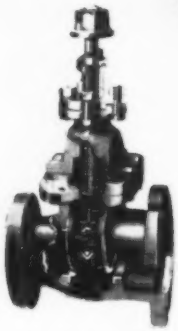

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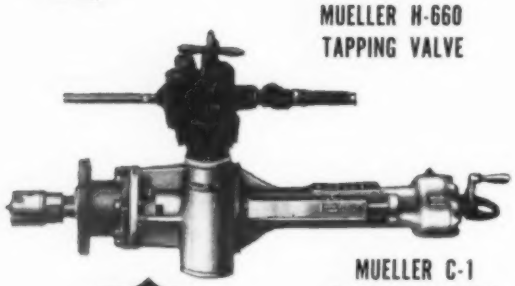

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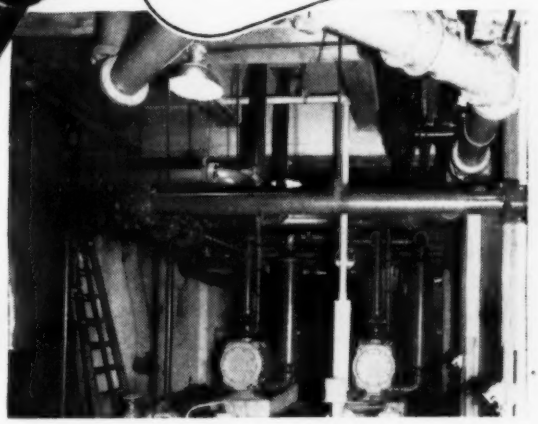

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WATER & SEWAGE WORKS

VOL. 95, NO. 11 NOVEMBER, 1948

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PRESTRESSED REINFORCED CONCRETE PRESSURE PIPE

How It is Produced and Some of Its Advantages

by

M. W. LOVING*
Consulting Engineer
GLENVIEW, ILL.

PRESTRESSED reinforced concrete pressure pipe, of excellent quality, is being manufactured at Cotorro, Cuba, near Havana, for the Cuban Government by the Pontusco Corporation of Cuba. This is a joint venture of the United States Pipe and Foundry Company of Burlington, New Jersey, and Pont-A-Mousson of Nancy, France. It is of interest that both of these firms are primarily engaged in the manufacture of cast-iron pipe in the United States and France, respectively. The name "Pontusco" is a combination of the names of the two companies.

The pipe for the Cuban Government is made in diameters of 24, 30 and 36 inches, and in lengths of 22 feet. Designed for a working pressure of 150 pounds

*Concrete Technologist

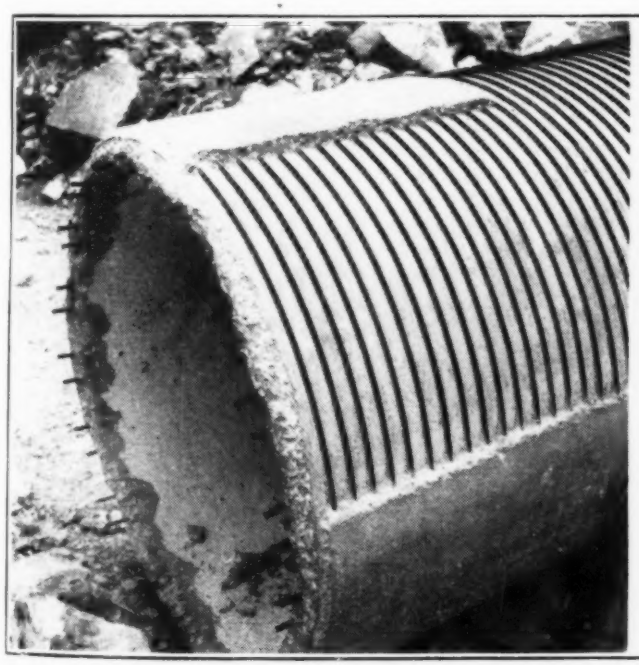


Fig. 1—Cut Section from a 24 in. Prestressed Concrete Pipe

(Note the uniform spacing of the circumferential and longitudinal steel wire. The concrete cover-coat is vibrated under and around the steel wire and is thoroughly bonded to the concrete inner shell or core.)

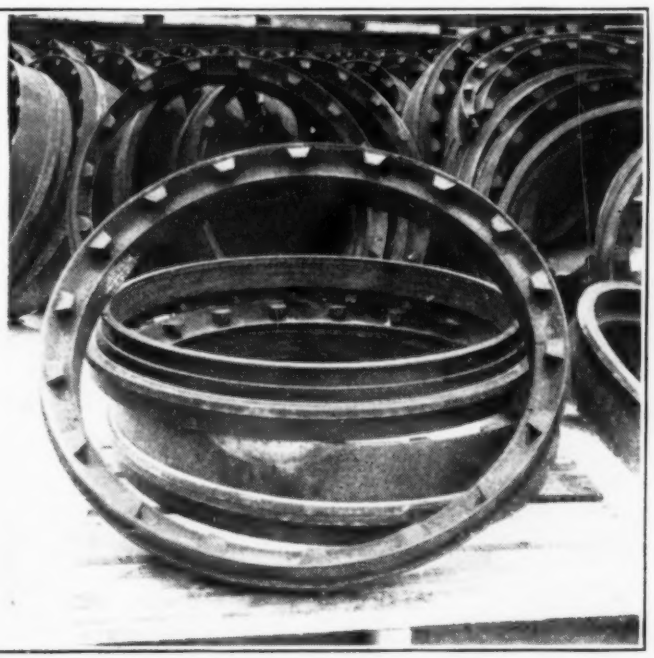


Fig. 2—Cast-Iron Joint-Rings Which Serve as End-Rings

(The longitudinal steel wire loops are hooked over the lugs of these rings, set in each end of the pipe mould, and the loops are then prestressed before the concrete core is spun.)

per square inch, full-sized pipe is tested to 250 psi. without leakage through the prestressed concrete inner shell, or core before the exterior concrete cover-coat is applied. The concrete inner shells for the 24 inch diameter pipe are only 1.5 inches thick; the 30 and 36 inch pipe are 1.75 and 1.9 inches thick respectively. After the longitudinally prestressed inner shells have been circumferentially prestressed a concrete cover-coat of about 0.75 inches thickness, for all sizes, is mechanically placed on each pipe.

The cut-section, Fig. 1, exposing the circumferential and longitudinal reinforcing, shows how the Pontusco pipe is made.

Fig. 3—Spinning Two 22 in. Lengths of 30 in. Pipe at One Time.

(The mechanical concrete charger can be seen at the far end of the mould spinning at a speed of 3,000 ft./min. at the rim.)

Longitudinal Steel Members

The concrete cores, or inner shells, are made by the centrifugal process in two-piece moulds. Each pipe has two cast-iron end-rings to anchor the longitudinal reinforcing wire. These end-rings also function as joint-rings. Lugs are provided on the end-rings (Figs. 2 and 9) over which the steel wire loops are fastened. The 0.218 inch diameter hot-rolled wire, received in rolls, is straightened with a machine similar in design to those used in the manufacture of wire nails. Cut to the required length to make the longitudinal reinforcing loop, the two ends of the wire are butt-welded. Interestingly, on test these welds equal the strength of the wire. The loops are stretched on a machine of unique design, with the weld near the center of the loop. With the end-rings in position at each end of the pipe mould, a workman hooks one end of the loop over the lug of the end ring; then with a mechanical "shoe-buttoner" the other end of the loop is hooked over the corresponding lug on the end-ring at the opposite end of the mould. This operation alone induces a stress of about 40,000 psi. in the longitudinal reinforcing members.

Manufacture of the Concrete Cores

After all the longitudinal steel reinforcing members are placed in position and prestressed as above described, the moulds are placed on the trunnions of the spinner. With the mechanical charger concrete of a plastic consistency, consisting of standard portland cement, sand and carefully graded crushed limestone and water, very thoroughly mixed, is placed in the mould while it is revolving at slow speed. Only enough concrete is first placed in the mould to produce one-half the shell thickness of the core and this is spun for 5 minutes. Then the rest of the concrete is placed in the mould which is then spun for about 20 minutes at a peripheral (rim) speed of about 3,000 feet per minute to densify the concrete inner shell. Two-phase spinning is necessary where the aggregates vary in specific gravity. Thus, the concrete is very dense, uniform in texture, and impermeable. By carefully examining the picture of the cut-section (Fig. 1) one can see how excellent the concrete is. Made of a very rich mixture, this concrete, after curing and aging exceeds 13,000 psi. in compressive strength. While this kind of concrete has been made in Australia, England, France and Sweden on a commercial basis for many years, it has seldom been

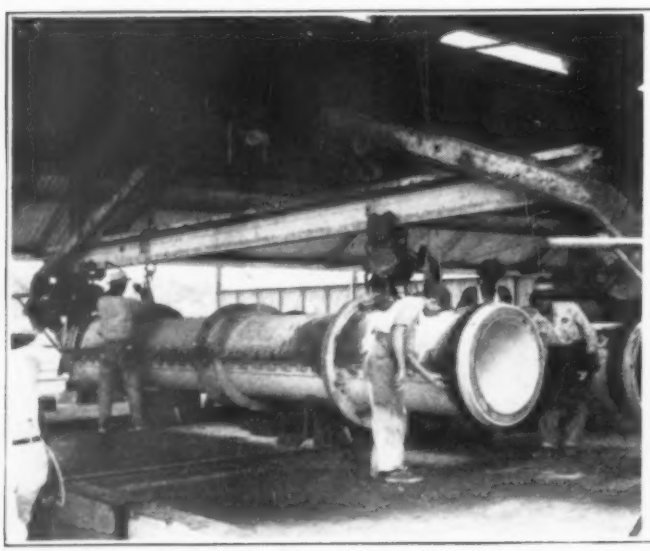


Fig. 4—Removing Spinning Rings and Latch Nuts of the Two-Piece Moulds.

(The large mechanical "tongs" shown above are employed to handle the moulds and the concrete cores simultaneously.)

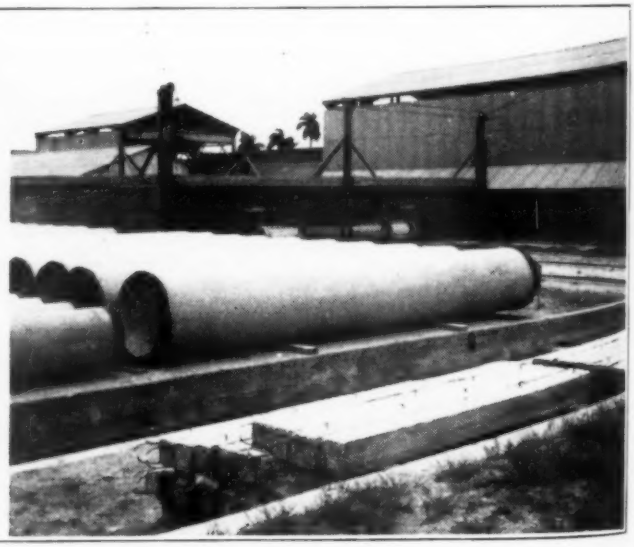


Fig. 5—Steam Curing Rooms in Background, with Lift-up Doors Open

(While yet in moulds, pipe is first steam-cured at about 150°F. and 100 percent humidity for 4.5 hrs. The cores are additionally cured for 2 weeks in curing yard shown.)

Fig. 6—Core Curing Yard—36 in. Pipe
(Well drained depressed tracks are employed for moving cores and finished pipe through the plant.)

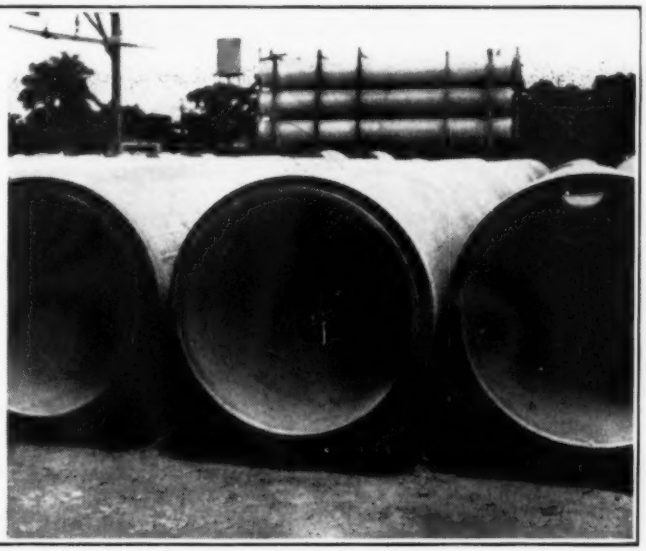


Fig. 7—Finished 30 in. Prestressed Pipe
(Note the flat car loaded with six 22 ft. lengths of this prestressed pipe.)

made in the United States. The steel mould, while spinning one of the concrete cores at Cotorro, Cuba, is shown in Fig. 3.

Curing the Concrete Cores

The moulds are then removed from the spinner, and with the cores (two being spun simultaneously), are transported to the curing rooms. While still in the moulds the concrete cores are cured for 4.5 hours with wet steam, providing a temperature of about 150 degrees F. and a relative humidity of 100 per cent. From the curing room, the cores, still in the moulds, are taken to the stripping shed. After the spinning rings are removed and the latch-nuts of the moulds are released by workmen, the two-piece moulds are removed with the mechanical tongs shown in Fig. 4. The concrete cores are then transported to the curing yard for an additional two-week curing period. The curing rooms and the industrial track for transporting the pipe can be seen in Figs. 5 and 6; the curing yard, in part, is also shown.

Circumferential Prestressing

After the two weeks curing period, the concrete cores are ready for the stress-winding with oil-tempered, spring-steel wire. The diameter of the wire used at Cotorro on the 24, 30 and 36 inch pipe is 0.187 inches, and has an ultimate strength of from 205,000 to 225,000 pounds per square inch. The yield point, however, ranges from 164,000 to 185,000 psi., and the cores are wound with this wire under a tensile stress of 100,000 psi., as the designed working stress for the steel The equipment used for this operation is of special design, because of the long length of the pipe (22 ft.) in proportion to its diameter. To avoid bending stresses in the vicinity of the center of the concrete core during the winding operation, the wire is wound in such a way that the stress on the core is the same from both sides. Even with the aid of pictures, it would be very difficult to effectively explain this unique operation. Then, too, I would hesitate to disclose too many details of this excellent equipment and the "know-how" of the producers. The helical wires, wound at a uniform pitch, are very securely fastened to the cast iron joint-rings.

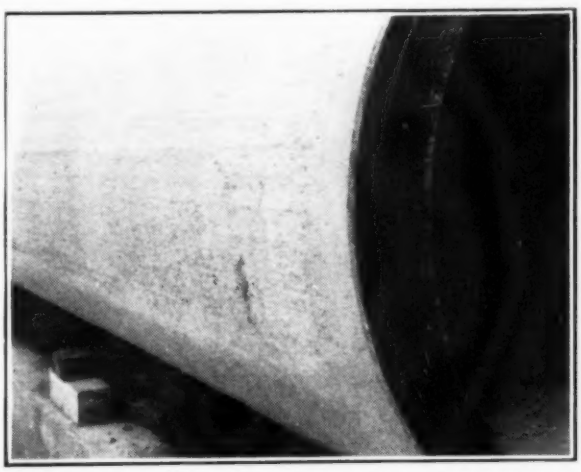


Fig. 8—Close-up View of Cast-Iron Joint-Ring
(Note the texture of the cover-coat which was applied with a high pressure vibro-buttering machine.)

The Concrete Cover-Coat

While in the horizontal position, the pipe is provided with a concrete cover-coat, Fig. 8, placed with a vibro-buttering machine. This equipment is so designed and efficiently operated that the cover-coat is forced under and around the stress-wound steel wire on the external surface of the concrete core. The bond of the cover-coat to the concrete core is perfect; this can be demonstrated at any time by trying to chip the cover-coat from the core. By examining the cut-section (Fig. 1) with an enlarging glass one can see how effective this precise work is.

To the writer an impressive observation was the noticeable absence of crazing and shrinkage cracks from the surfaces of the pipe, some of which had been exposed in the storage yard for more than six months. This was of especial interest because the same end results were obtained by the Lewistown Concrete Pipe Company of Hillside, Illinois, from 1938 to 1943 in the manufacture of prestressed reinforced concrete water pipe for Hammond, Indiana; Chicago, Illinois and the Standard Oil Company of Indiana, Wood

River, Illinois. One of the most impressive pictures I took at Cotorro comprises a close view of the ends of three pipe, with a loaded freight car in the background—see Fig. 7.

Specials

All specials are made of sheet steel, not prestressed, and the working stress of the specials is 12,500 psi. The excellent concrete linings and coatings of the specials shown in Fig. 10 was done by Cuban workmen employing hand methods, these men having been trained and supervised by a French concrete engineer. The joint rings of the specials are made with steel and are welded to the sheet steel diaphragm. These steel joint rings have the same shape as the cast iron male and female joint-rings—Fig. 9—so that when they are installed in a pipe line, the rubber gaskets effect a tight seal.

Cast Iron—Rubber Gasket Joint Assembly

A typical section of the Pontusco joint assembly is shown in Fig. 10; from this one may see how the stress-wound wire is fastened to the cast-iron joint-rings, at each end of the pipe. The longitudinal steel members are placed in the center of the wall of the concrete inner shell. This excellent, self-centering joint provides for both expansion and contraction of the pipe line, due to the wide seasonal variation of the temperature of the water conveyed. When and if the pipe line settles, or if to some extent there is movement of the soil-mass, this flexible joint will remain tight. Because the section through the rubber gasket is a truncated wedge the higher the internal pressure the tighter the joint becomes. The inner surfaces of the joint rings are machined to true circles and when the pipe are drawn together, the gaskets are uniformly compressed around the periphery of the joint. Thus joint blow-outs are impossible. The shape of the gasket is such that when the pipe are drawn together it is compressed and not subjected to tensile stresses. The latter is a distinct advantage in its favor and the life expectancy of the rubber becomes greater automatically.

Prestressed Concrete Pipe Not a New Venture

Some of the early experiences in the design and manufacture of prestressed concrete pipe are set forth in the French journal, *"Genie Civil"* for May 9, 1931. Concerning this kind of pipe, as made in Prague, Czechoslovakia, here is an approximate translation: "The only means to give good results (water-tight pipe) is that of exercising outside the pipe a pressure sufficient to create a permanent compression of the concrete. This compression must be high enough to balance the tension due to the water pressure . . . To obtain this, I have in 1923 envisaged wrapping a helix of steel wire under tension outside the pipe. I described the application in *"Genie Civil,"* for November 5, 1927 . . . Since one must not pass the limit of elasticity of the wire, it is often desirable to choose a steel of high limit of elasticity in order to make it work at a high value sufficiently within the limit, and to have the certainty that this limit will not be exceeded."

When Mr. Sverre Fjeldstad, a civil engineer from Stockholm, Sweden, was here in June 1948, he told me about the manufacture of prestressed concrete pipe in Sweden, Germany, France, Czechoslovakia and Switzerland. At his suggestion I wrote the International Siegwartbalken-Gesellschaft, Luzerne, Switzerland, and received a reply in a letter dated June 30, 1948. The following is copied from this letter:

"In our report No. 106, January, 1937, on page 46, you will find the picture Mr. Fjeldstadt told you about, showing a plant for winding high-tensile strength steel

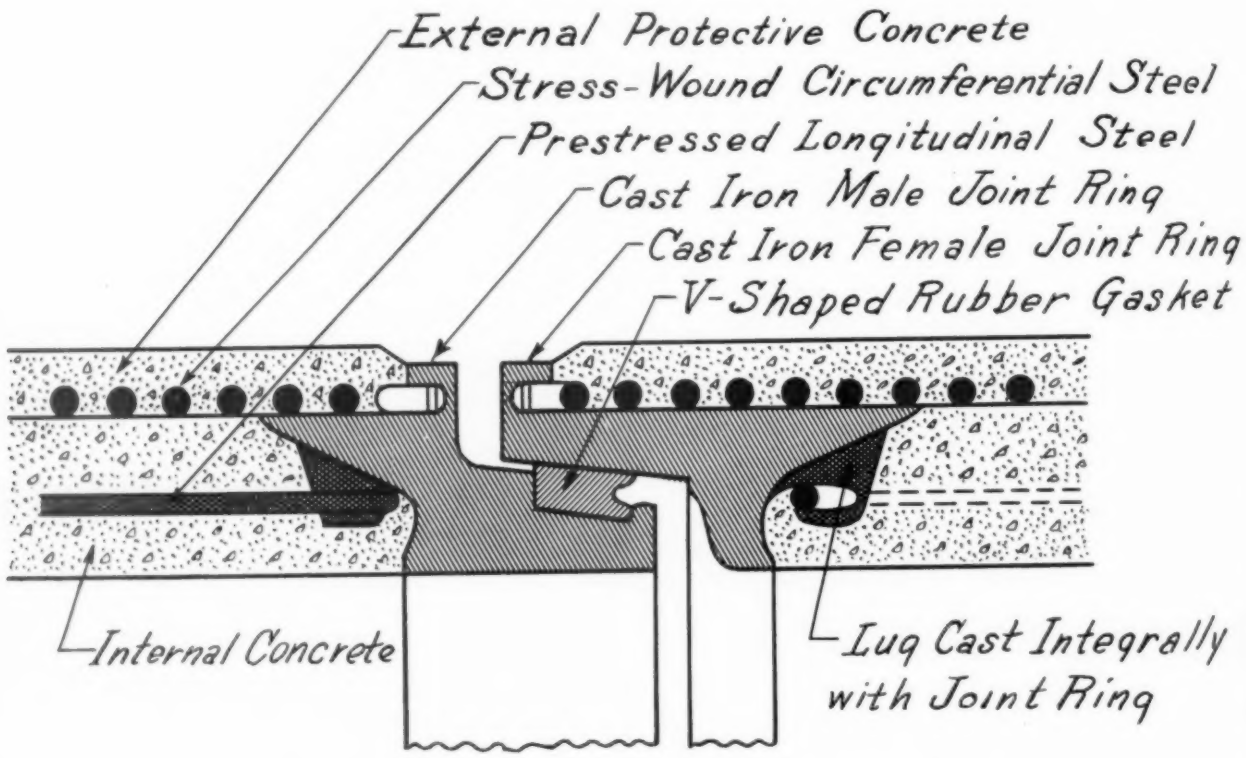


Fig. 9—Typical Joint Section of the Pontusco Prestressed Pipe

(Note the lug arrangement on the joint-rings over which the longitudinal reinforcing wires are looped and prestressed before the core is poured. Also note the V-shaped rubber joint gasket which tightens with pressure increase.)

wire on Vianini pipes. Our latest Swiss patent for this machine is No. 234557, inventor is Favre & Cie. AG. Zurich. The problem to make prestressed reinforcement on concrete pipes is a very old one. We think that Mr. H. Siegwart, a Swiss engineer who established our company in 1903, was the first inventor who used this method as early as 1910. You will find an article concerning the development of prestressed pipes in "Beton und Eisen" XXXVII Jahrgang 1938, Heft 10, published by Prof. Dr. Ing. Kleinlogel, Darmstadt. In this article you will find, too, the results our German licensee has gotten with prestressed Siegwart and Vianini Pipes. On the other hand, Vianini Roma, the original inventor of the Vianini plant, has developed in the last 20 years a method for the making of prestressed Vianini pipes. Our Czechoslovakian licensee, the Lanna Akciova Spolecnost at Prague, has—besides our company—Vianini Roma and Zublin Stuttgart, developed her own system for prestressed Vianini pipes.

"From all these facts you will see, that the principle to make prestressed concrete pipes cannot be protected by patents anymore. The only means of securing a certain protection is to apply for a patent concerning the machine for the winding of the reinforcement."

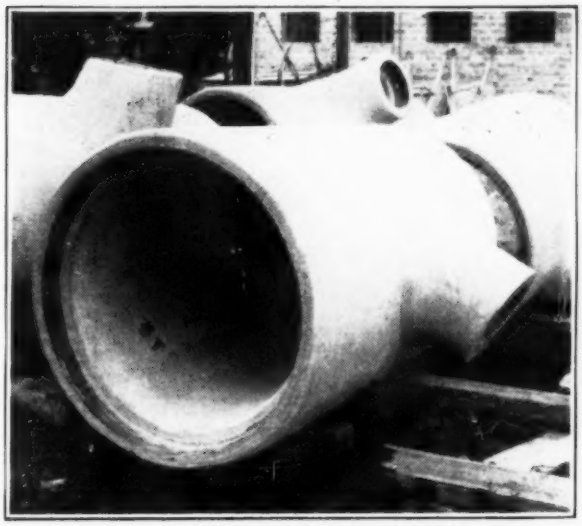


Fig. 10—Specials

(All hand work by trained Cubans. Note the excellent workmanship obtained.)

Hydraulic Advantages

The concrete inner shell, or core, is in compression at all times and the compressive strength of the concrete is reduced as the internal hydrostatic pressure, and the stress of the circumferential wire, increases. In properly designed pipe, the concrete is never subjected to tensile stresses, including shrinkage cracking. Because the concrete is always in compression, and the steel in tension, the section of pipe functions as an elastic ring; and in the case of long length pipe, also as a flexible beam. The significance of both of these characteristics in pressure pipe needs no emphasis to the hydraulic engineer or the practical water works man.

When and if the pipe line is subjected to hydraulic shock, such as water hammer, so long as the steel is not stressed beyond its yield point there will be 100 per cent recovery. This has often been demonstrated by subjecting full-sized pipe to internal pressures beyond those specified in the design. In these tests, or rather demonstrations, the concrete core is subjected to tensile stresses and will crack longitudinally. Water will escape rapidly through these cracks; but when the pressure recedes to normal, the cracks in the core will be closed by the compressive force of the elastic circumferential wire and the core again becomes absolutely water-tight. Even when pipe may be over-stressed in a pipe line, as described above, the cracks in the concrete core will be sealed by autogenous healing. That is, in the presence of water calcium hydroxide forms in the cracks and is converted to calcium carbonate (marble) which is just as strong and impermeable as the concrete, if not more so. This flexible quality of prestressed concrete pressure pipe which is self-healing is considered a distinct advantage by those experienced in its use.

The greatest pressure to which any prestressed concrete pipe line has been subjected, so far as I know, was disclosed to me at Cotorro, Cuba, by M. Jean Louis Contenson, General Manager, Pontusco Corporation of Cuba. Through M. O. Peirce, Chief Engineer, M. Contenson described and showed me pictures of a penstock built at a power plant on the Selves River in the Province of Garonne, France, in 1946. It was constructed of prestressed concrete pipe 63 inches in diameter, shell thickness 5½ inches and in lengths of 6 meters—19.68 feet. The test pressure of this pipe line was 795 pounds per square inch, without any leakage through the concrete shells of the pipe or at the joints, of the same design as shown in Fig. 9. Before concluding this section, I wish to add that the concrete engineer of the Pontusco Corporation of Cuba is M. Frederick Schiff-Francois, who together with Mr. Contenson and Chief Engineer Peirce, is responsible for the production of this excellent prestressed concrete pipe. All the rest of the superintendents, foremen and workmen are native Cubans, trained from scratch to make the best prestressed concrete pipe and specials that I have seen anywhere.

Structural Advantages

On September 1, 1939, I saw a 24 inch diameter, 12 foot long prestressed concrete pipe tested by the standard, A.S.T.M. 3-edge bearing method to 300,000 pounds—the limit of the testing machine. Because a high percentage of the load was concentrated at the bell end of the pipe, a fine crack developed at this point; just as soon as the load was released, the crack closed and could not be seen. What the ultimate load, required to crush this pipe, would have been can only be determined when pipe of like design and manufacture are tested to destruction.

These prestressed concrete pipe referred to above were made by the Lewistown Concrete Pipe Company at Hillside, Illinois, for a sewage force main at Hammond, Indiana. The pipe were designed by J. E. Miller, president of the Company. The concrete cores were made by the centrifugal process and were spun in two layers, as at Cotorro, Cuba, and for the same reasons. The longitudinal steel members were twelve 5/16 inch rods placed in the center of the 2.5 inch shell of the core and were prestressed to about 70,000 psi. before spinning. After adequate steam curing for about 48 hours, the concrete then had a compressive strength of about 7,000 psi.—the concrete cores were stress-wound with oil-tempered spring steel wire on a pitch of one inch and at 90,000 psi. The wire used was 6 gage which has a diameter of 0.1920 inch and a sectional area of 0.028953 square inches. The one inch concrete cover-coat was placed by the vibrocast method, while the pipe was in a vertical position.

Subsequently, Mr. Miller manufactured some 48 inch diameter and 5 foot long pipe, for extraordinary loading conditions, at the request of the bridge engineer of one of the railroads. Ordinary reinforced concrete sewer pipe, with a shell thickness of 5 inches and made with concrete having a compressive strength of about 4,000 psi., was

stress-wound with 6 gage wire on a pitch of one inch. The sectional area of the circumferential steel was 0.348 square inches per foot of pipe. No prestressed longitudinal steel was used in these particular pipe.

When tested by the 3-edge method a fine crack developed at 37,000 pounds per foot of the pipe, again the limit of the hydraulic jack used to apply the load. Just as soon as the load was released, the crack closed and could not be seen because the concrete was again in compression and the steel wire had not been stressed beyond its yield point.

The A.S.T.M. load requirements for reinforced concrete sewer pipe, with a shell thickness of 5 inches and a steel area of 0.21 square inches per foot for 48 inch diameter are: 3400 pounds per foot at 0.10 inch crack and 5100 pounds per foot at ultimate load, when tested by the 3-edge method. The record test result of reinforced concrete pipe of 48 inch diameter and a shell thickness of 5 inches with a steel area of 0.55 square inches per foot, was 13,500 pounds per foot at 0.01 inch crack and 16,250 pounds per foot at ultimate load. The Pontusco pipe at Cotorro, Cuba, was tested by the 3-edge method and is far above the test results of pipe of the same design commercially produced in this country.

Because the concrete is always in compression in prestressed concrete pipe of proper design when used for high internal water pressure or for extraordinary external loading requirements, it is practical to design and manufacture this kind of pipe to meet any conditions within reason. And it is desirable that pipe should be made and tested in this country so that standard specifications can be prepared and then the practicing engineers of the United States can see for themselves what a remarkable product prestressed concrete pipe is when compared with any other kind of pipe manufactured and used today.

The engineers of many other countries are unable to buy steel and cast iron pipe because these metals can not be obtained, and by force of necessity, the engineers and the manufacturers had to develop prestressed concrete pipe. By using high tensile strength steel wire, with working stresses of 100,000 pounds per square inch, and using concrete cores in compression when stress-wound with wire, they have developed this class of pipe. The operations in Cuba and by the Lewistown Concrete Pipe Company, certainly should be of real interest to practicing engineers of today. High prices of steel and cast-iron pipe and the shortage of both, indicates that we will have to follow the lead of the engineers and manufacturers across the seas.

Life Expectancy of Prestressed Concrete Pipe

Concrete, like steel or cast iron, is as good as you make it and the concrete made and used in the manufacture of prestressed concrete pipe is always in compression. Its advantages in this direction have never been questioned by any responsible and experienced engineer. The 13,000 pound compressive strength concrete used by the Pontusco Corporation of Cuba, and the concrete of equal quality used earlier by the Lewistown Concrete Pipe Company and others, is not compressed by the stress-wound wire to more than 3,000 psi. And, when the pipe lines are in normal operation the compressive stress of the concrete is reduced but it is never subject to tensile stresses. Thus, the life expectancy of 100 years, claimed by the manufacturers, seems to be reasonable.

"Jo" Conners Feted in 38th Year of Main Cleaning

On Tuesday, September 14, during the New England Water Works Ass'n Convention, the National Water Main Cleaning Co. gave a luncheon in honor of Joseph B. Conners in recognition of long and efficient service with the company.

Joseph B. Conners

During the luncheon, Mr. Conners was presented with a service emblem in commemoration of more than 37 years of continuous active service with the National Water Main Cleaning Co.

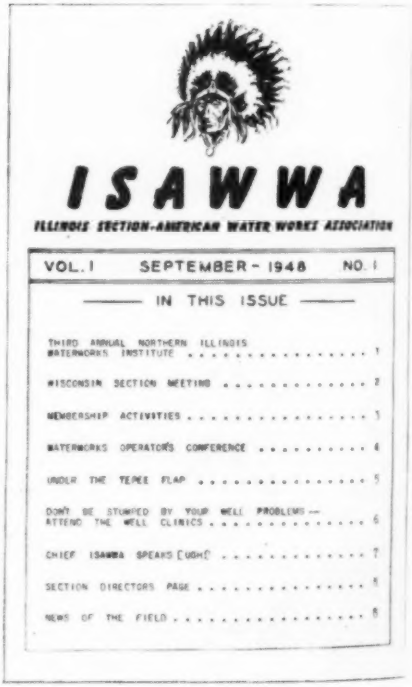
Mr. Conners' background in the waterworks field dates back to the year 1909 when he started with the Trenton Water Department. In 1911 he joined the National Water Main Cleaning Co. and has been actively engaged in the waterworks field since that time. In 1920, Mr. Conners went to Boston, Mass., to take charge of National's operations in New England and has made his headquarters in Boston for the past 28 years.

Constituting the first of a number of similar presentations to be made to National employees with long periods of loyal service, presentation of the first gold service emblem was made by National's president, J. A. de Camp.

ISAWWA NEWS MAKES ITS APPEARANCE

Worthy of note is the first issue of "ISAWWA News", published as a quarterly bulletin by the Illinois Section of the Am. Water Works Assn., the initials of which make up the name "ISAWWA".

The quarterly issues of this handy sized 5½ x 8½ inch bulletin of 8 pages and cover of "water works yellow" are intended to keep members of the Illinois Section posted on water supply developments and news of water works personnel in the State during the period between annual meetings of the Section. Section activities will be emphasized along with scheduled meetings, conferences and short courses of water works groups in Illinois. The principal objective is an informed membership and encouragement of meetings' attendance and membership build-up of various water-works operators' organizations and of the Illinois Section in particular.



ISAWWA

ILLINOIS SECTION-AMERICAN WATER WORKS ASSOCIATION

VOL. I SEPTEMBER - 1948 NO. I

IN THIS ISSUE

THIRD ANNUAL NORTHERN ILLINOIS WATERWORKS INSTITUTE 1
WISCONSIN SECTION MEETING 2
MEMBERSHIP ACTIVITIES 3
WATERWORKS OPERATORS CONFERENCE 4
UNDER THE TEPEE FLAP 5
DON'T BE STUMPED BY YOUR WELL PROBLEMS — ATTEND THE WELL CLINICS 6
CHIEF ISAWWA SPEAKS (UGH!) 7
SECTION DIRECTORS PAGE 8
NEWS OF THE FIELD 8

MINN. SECTION'S WINNIPEG MEETING

Largest of Record by Far, as Well as Most Enjoyable

Reported by
ARTHUR F. MELLEN
Superintendent of Filtration
MINNEAPOLIS

IF the members of the Minnesota Section of the American Water Works Association had previously thought of Winnipeg only as a distant city across the border far to the North, they now know it to be a city with fine convention facilities, modern shopping districts, an attractive residential section and an unrivaled warmth of welcome for its guests.

Chairmen

Wm. D. Hurst, City Engineer, Winnipeg (Retiring)

H. G. Tischer, Mgr. Water Dep't., Duluth (Incoming)

The 32nd Annual Conference of the Section was held in the Royal Alexandra Hotel, Winnipeg, Manitoba, Canada, on Wednesday and Thursday, September 1st and 2nd, 1948.

The combination of an unusually cordial invitation on behalf of the city of Winnipeg and the anticipated pleasure of the annual conference resulted in the largest attendance in the history of the Section. From Minnesota 85 were registered; from North Dakota 15; from South Dakota 13; from other states 5; from Canada 62 and United States and Canadian manufacturers' representatives numbered 60. This total of 240, together with the 82 ladies registered, gave a grand total of 322.

Of special interest was the fact that A.W.W.A. President Linn H. Enslow of New York, two past Presidents, Louis R. Howson of Chicago and Leonard N. Thompson of St. Paul, as well as Dr. A. E. Berry of Toronto, Secretary of the Canadian Section A.W.W.A., were in attendance at all the sessions.

The Conference was called to order by Chairman W. D. Hurst, Winnipeg's City Engr., who introduced His Worship Garnet Coulter-K.C., Mayor of the City, who gave a very warm address of welcome, was present throughout the meeting and with Mrs. Coulter attended all social functions.

Winnipeg's Dinner

All attending the Conference were guests of the City of Winnipeg at a resplendent dinner held the evening of the first day. The dinner was presided over by Alderman H. C. Morrison-K.C., of the City Council and the official welcome was given by His Worship Mayor Coulter. It was of particular interest that the Chairman of the Section was Mr. William D. Hurst, City Engineer of Winnipeg who replied on behalf of the Section, as did also Mr. Linn H. Enslow on behalf of the Parent Association. The musical selections were particularly well received.

Awardee

L. N. Thompson, Genl. Mgr., Water Dep't., St. Paul, Minn. (Fuller Award Winner)

Vice-Chm'n
Arthur F. Mellen, Supt. of Filtr., Minneapolis

Nat'l Director
D. B. Morris, Pres., Lyon Chemicals Inc., St. Paul

Business Meeting

The annual business meeting was held at the Thursday luncheon. The reports of the committees and of the Director of the Section were given. The report of the Nominating Committee was adopted; the officers for the coming year being H. G. Tischer, Manager Water, Gas and Sewage Department, Duluth, Minn., Chairman. Arthur F. Mellen, Supt. of Water Treatment, Minneapolis, Minn., Vice Chairman. R. N. Jenson, Supt. of Water Works, Grand Forks, No. Dak. and R. Rees, Supt. Water Dept., Sioux Falls, So. Dak., Trustees. Among new items of business was a proposal to license water treatment operators on a voluntary basis. Linn H. Enslow, President A.W.W.A. and Editor of *Water & Sewage Works*, addressed the meeting and paid a high compliment to the Chairman of the Section, referring to him as an outstanding executive and engineering official. He complimented the City of Winnipeg on having such an outstanding public servant who is successfully carrying on the complicated engineering work of the city. He spoke of the growth and scope of activities of the American Water Works Association. He also stated that all evidence points to the fact that poliomyelitis is definitely not a water borne disease.

Secretaries

R. M. Finch, W. & T. Co., Chicago (Minn. Sect.)

A. E. Berry, Prov. Dept. Hlth., Toronto (Canadian Sect.)

Cocktail Party and Banquet

Prior to the banquet the members were guests of the manufacturers, jobbers and contractors of Winnipeg at a cocktail hour.

The annual banquet was held Thursday evening, the members of the City Council this time being guests of the Association. It is interesting to note that 14 of the 18 Aldermen of the City Council and their ladies were in attendance. Chairman Hurst very graciously introduced the head table guests and A.W.W.A. President Linn H. Enslow spoke of the high anticipation he had had in looking forward to the Section meeting in Winnipeg and that the Conference, the hotel accommodations, the entertainment and facilities put at the disposal of the members of the Conference exceeded all expectations. He paid high compliments to Winnipeg for the manner in which it operated its utilities. The report of the Fuller award Committee was given at the dinner in which Leonard Newton Thompson, General Manager, Water Department, St. Paul, Minn., was named the awardee and was cited "for his devotion and earnest and unselfish effort in promoting better water works practice throughout his 30 years of service in the water works profession." Mr. Thompson, in response, expressed his appreciation for the honor bestowed upon him. Chairman Hurst then presented the incoming Chairman Mr. H. G. Tischer of Duluth. Mr. Louis R. Howson, Consulting Engineer, Chicago, and Past President of A.W.W.A., then gave an interesting address on "An Engineer's Bird's-eye View of Alaska," accompanied by color slides. Following the dinner musical and dance specialty entertainment of a very high order was much enjoyed by all.

One of the outstanding features of the days spent in Winnipeg was the entertainment provided for the ladies. A special parlor in the headquarters hotel was at their disposal at all times and on Wednesday the ladies were taken by private cars to the Fort Garry Country Club where luncheon was served to 175 ladies. The reports of the beautiful setting of the Country Club, the delightful luncheon, the inspection of the old Fort and particularly the exceptional landscaping and beautiful flowers was very complimentary. On the following day many members of the local committee

Hosts

H. L. Briggs, Ass't. Genl. Mgr. City Hydro System, Winnipeg

Garnet Coulter-K. C. The Mayor of Winnipeg

H. B. "Hank" Scott, Alderman Master of Ceremonies on the Hydro Trip

extended additional courtesies to the ladies of the Conference by assisting them in seeing other points of interest in the city and also in shopping in the stores of which Winnipeg is justly proud.

"Waterworks Special" to Hydro Stations

While the formal sessions were completed Thursday all looked forward to the inspection trip of the following day. The City of Winnipeg owns hydro electric power plants located at Pointe duBois and Slave Falls. For the 80 mile trip a special four coach train was provided with the compliments of the City of Winnipeg Hydro-Electric System. The first development was at Pointe duBois. This was opened in 1911 having a capacity of 105,000 horse power. Upon leaving the train we were shown a well laid out village for the employees, an employee owned store, a church, a medical clinic and a very modern school house. We were directed to the community hall where a very fine complimentary luncheon was served. The power developments were explained at the luncheon after which the train proceeded to a point six miles down the Winnipeg River to the Slave Falls Plant, completed only this year, with a capacity of 96,000 horse power. Guides showed us the details of the power plant including the generator, turbine and gate rooms. After seeing the plant and enjoying the unusually wild scenery, while some went fishing and some of the ladies went wading, the train took us back to Pointe duBois where we inspected Winnipeg's 37 year old power plant. While many of us may have had but little actual knowledge of the operations of such plants the orderliness and cleanliness of the buildings and grounds was a matter of general comment, as also was the phenomenally low domestic power rate of 0.77c per k.w. to Winnipeg's home owners. After inspection of the power plant and the beautiful surroundings of the village we were again invited to the community hall where supper was served. An outstanding feature of this whole visit to the hydro plants was the evidence of expert planning on the part of those responsible and there appeared to be nothing overlooked. Soft drinks were served throughout the train trip, wandering minstrels entertained with music and encouraged group singing. The final touch was given when all of the ladies of the inspection party were presented with a box of chocolates, the wrapper being marked with the occasion and date of the trip.

In retrospect the feeling was unanimous that the Winnipeg Conference not only exceeded all expectations as to attendance, fine program and outstanding cordiality on the part of our hosts, but that it has set an extremely difficult mark to shoot for in succeeding meetings.

PAPERS AND DISCUSSION

"Maintenance and Operational Problems of the City of Winnipeg Water Works System." N. S. Bubbis, Engineer of Water Works and Sewerage, Winnipeg, Canada.

The source of Winnipeg's water supply is Shoal Lake, the western arm of Lake of the Woods. An aqueduct 96 miles in length, which was put in service in 1919, brings the water into the City by gravity to reservoirs from which it is chlorinated and delivered by high lift pumps directly into the distribution system. There are 328 miles of mains laid 7 ft. 6 in. deep to be below the frost line.

There is a separate system consisting of 13 miles of water mains with 161 hydrants which serves as a special high pressure system for fire protection, delivering water at 300 lbs. per square inch.

Some Random Shots

Here and there on the lawn up at Hydro's Generating Station at Pointe DuBois. The center picture is of Winnipeg's attractive Central Pumping Station in the City.

On the Trip to HYDRO'S Generating Stations.

Hydro's Engine No. 3, on "Water Work's Special." No. 3 already prepared for Winter duty.

Some enterprising youngsters set up the well known Lemonade Stand.

A sumptuous luncheon served in Hydro's Club House at Pointe Du Bois.

The Lemonade Stand does a land-office business. Louie Howson enjoys a glass.

New Dam and Gates at the Slave Falls Generating Station on Winnipeg River

The local soil, called Red River gumbo, is a very active alkaline soil which also contains objectionable sulphates. About 180 main breaks occur each year, mostly due to a form of graphitization. Copper service pipe seems to resist soil corrosion better than lead. These services are installed at a minimum depth of eight feet. A regular schedule has been set up for the inspection of meters, those one inch and over every two years and smaller meters only every seven years. Careful attention is given to claims of excess meter charges, the Department even going so far as to request the customer to witness the test of the meter in the shop.

Because of the large number of main breaks expected each year the Department has installed many gate valves in the system so as to inconvenience as few customers as possible during the shutdown period. These valves are so placed that the isolated section of main need be no greater than 600 feet.

Soil corrosion also necessarily affects valves and hydrants. In consequence, to prevent damage, spindles, bolts and trim are made of stainless steel.

To facilitate maintenance of hydrants the Department has chosen one type which is manufactured to Winnipeg's specifications by a local firm. Local foundries using the city's patterns now make the cast iron and brass castings. These castings and other parts are machined and assembled by the City in the Engineering Department's machine shops. This procedure has been economical in operation and is considered very satisfactory. Winnipeg also machines most of its meter repair parts. Hydrants in the commercial area are inspected at least twice a week. The department has used radio communication with its emergency trucks since 1934. This was changed in 1939 to a two-way communication system. In 1947, in co-operation with the Fire Department, a radio station with its own radio channel was put into service. This system has greatly increased the effectiveness of the Department's service to the public.

The speaker said that specifications written by the A.W.W.A. committees have been very helpful. Efforts involving good design and standardization have resulted in economical maintenance and speed of repairs. The inspection work has minimized what otherwise might be expensive repairs and has kept equipment such as hydrants and valves in good working condition. He emphasized the value of complete records both for use in the office and on the emergency and service trucks. The adoption of suitable mechanical equipment has not only cut maintenance costs but has also speeded up main repairs and other maintenance work at a time when there has been a labor shortage. He emphasized the value of good public relations and good relations between management and employees of the Department. A four-year apprentice training plan has helped much in building up high grade personnel in the Department.

"Analysis of Water Works Operating Data." Prof. Geo. J. Schroepfer, University of Minnesota, Minneapolis, Minn., in co-operation with A. F. Johnson, Harris Seidel and Bahig Al Hakim, students.

The authors referred to an A.W.W.A. report under the title "A Survey of Operating Data for Water Works in 1945," published in the *Journal* February, 1948, page 167. This survey includes a mass of information on production, consumption and financial data pertaining to a number of water works systems. Feeling that it might be difficult to draw conclusions therefrom without detailed analysis the authors have undertaken a study to determine the usual values, trend, spread and possible interrelation of these data hoping it would be of general usefulness to water works men.

The report was based on returns from 462 water works properties. The analysis is divided into three parts, (1) production and sales, (2) physical data and (3) financial data. In the first section production is studied by population groups, geo-

Head Table at the City's Dinner

From left: (1)—Mrs. Garnet Coulter, "First Lady" of Winnipeg; (2)—Dr. A. E. Berry, Director of Sanitary Eng., Provincial Dept. of Health, Toronto; (3)—Mrs. P. L. Charles, wife of Chairman of Committee on Arrangements, who was prevented from attending on account of sudden illness; (4)—Linn H. Enslow, Editor, "Water & Sewage Works", and President of A.W.W.A.; (5)—The Master of Ceremonies, Alderman H. C. Morrison, K.C.; (6)—Alderman Morrison again; (7)—The Mayor of Winnipeg, Garnet Coulter, K.C.*; (8)—Mrs. H. C. Morrison; (9)—Winnipeg's City Eng'r. Wm. D. Hurst, host and chairman of the Minn. Section.*

*(*To those who may not know, the initials K.C. denote the distinction of being a King's Counsellor.)*

graphical locations and in terms of rates; sales by population groups and percentage of production sold; and finally a study of private supplies by population groups and regions is included. In the second section physical data of the system such as the number of miles of mains and distribution of hydrants and valves are analyzed. The third section of financial data covers book values, operation and maintenance costs and revenues per capita in relation to population production and source of supply. Rates are analyzed by population production and amount used. Also included is a comparison of public and private supplies from a financial standpoint. The data is analyzed on the basis of six population groups of cities from 10,000 population up to over 500,000. The results of the study have been set forth in 22 tables and 23 revealing diagrams.

It was found that the mean production for all cities was 125 gallons per capita per day and that the *median* value was 110 gallons. In the geographical location study the country was divided into seven regions. Data is given of production in the various regions which showed the South and New England regions roughly 20% lower in per capita production than the country as a whole. The study of sales of water showed a range from 28 to 430 gallons per capita per day the *mean* being 99 gallons. The per capita sales increased in general with the size of the city.

In the study of the physical characteristics it was found that the miles of mains vary from 0.22 to 8.34 per 1000 population with a mean of 2.77. The annual costs of operation and maintenance of 417 communities had an overall range of from $0.81 to $15.91 with a mean value of $3.02 per capita. The mean values of operation and maintenance costs tend to decrease with an increase in population. Generally speaking the trend of mean values is toward increased per capita costs with increase in production. The overall range for book value per capita was from $7.84 to $437.37 with a mean of $56.73. These values are for the entire water supply system with no breakdown into distribution system and purification plant. The relation between book value and production is shown in two tables. The revenue per capita ranges from $1.37 to $15.86 with a mean value of $6.10.

The data for rates in population groups is shown in two tables. In accordance with usual rate structures, the rate per 1000 cubic feet of water used decreases with increased consumption. Median values run from about $1.90 for the first 1000 cubic feet per month to $0.75 per 1000 cubic feet for 1,000,000 cubic feet per month.

[Ed. Note—This paper, to be published in an early issue of the *A.W.W.A. Journal*, will provide information of marked value to water works managers who will take time to evaluate the data presented.]

"The Necessity for and Methods of Adjusting Rate Structures to Meet Rising Costs of Labor and Materials." Louis R. Howson, Consulting Engr., Alvord, Burdick and Howson, Chicago.

In presenting this subject the speaker was on very familiar ground to which he has made outstanding contributions in recent years*. He once more proved that a 30% increase in rates is generally required if water works are to continue improvement of their services and expansion of their facilities to meet growing demands.

Net revenues have not kept pace with the sharply increased cost of items entering into water works construction, operation and maintenance. He urged that cost estimates of new work be rigidly based on anticipated costs as well as current construction costs. Most Departments will never be able to catch up with deferred construction and maintenance unless water rates are materially increased.

"The Development of Ground Water Supplies." E. W. Bennison, Edward E. Johnson Co., Inc., St. Paul, Minn.

*Note: The reader is referred to Mr. Howson's discussion in the Sept. 1947 issue of this magazine—"Adjusting Rate Structures to Rising Cost Levels."

The development of ground water does not mean merely drilling a well. It includes the application of the best available technical knowledge to secure an adequate dependable water supply free from pollution and in accordance with the best principles of conservation. It should include a knowledge of the basic laws of ground water flow, ground water chemistry, local geology and the use of power with pumping equipment. Adequate study and planning should be a part of every development together with full recognition of the legal rights of all concerned.

There are large areas where ground water supplies are very limited. Prospecting by test drilling and geo-physical methods are valuable particularly in unknown areas. Drill test holes four to six inches in diameter are usually considered a very good investment in locating dependable supplies, and it is often necessary to use at least three such test holes in order to secure the necessary data.

The speaker referred to the four methods of well construction; namely, driving, digging, hydraulic and drilling. Choosing the proper length and opening size in screens and the type of gravel treatment, if used, is very important in proper well development. Wells have been drilled without giving proper consideration to the relationship between diameter and yield, drawdown and yield, screen length, etc. In many sections of the country ground water is being over used, water tables are falling and in some places there has been intrusion of salt water, and this has now become a matter of needed concern in the field of national conservation.

"The Proper Design of Elevated Storage in Semi-Arid Areas." John M. Glasgow, Perkins and McWayne, Architects and Engineers, Sioux Falls, South Dakota.

Elevated storage in a distribution system is provided to maintain more uniform pressures. It furnishes reserve in case of temporary interruption of supply and economizes in cost and operation of pumping equipment,

Mr. & Mrs. Dave Morris, Lyon Chemicals, Inc., St. Paul, Minn.

Mr. & Mrs. A. E. McDonald, Head, Dept. of Civil Eng., Univ. of Manitoba, Winnipeg

The Pilchers of Fort Dodge, Ia. "C. B." is Comm. of Public Wks. Mrs. P., son "C. J.," Jane and Nancy.

Mr. & Mrs. Leonard Thompson, Genl. Mgr. Water Dept., St. Paul

Mr. & Mrs. H. L. Briggs, Asst. G. M., City Hydro, Winnipeg

equalizes the domestic and industrial demands and provides reserve for fire requirements. The variation in demand is an individual problem for each city. It is effected by local conditions such as climate, use by industry, extent of storage and extent of service meters. In semi-arid regions climate is probably the greatest single factor effecting demand.

Since the maximum day is usually considered the basis of design for elevated storage, data has been developed to show the ratio of the maximum to the average day. The author uses data for the years 1923 to 1947 inclusive at Sioux Falls, South Dakota, as the basis of his study. The ratio of the maximum to average day averages 166%. He also gives water consumption data from other cities in the State of South Dakota and nearby states. While it is basically considered economical and necessary only to provide storage to equalize demand on the maximum day, in actual design other economic factors must be balanced against the advantages of complete equalization.

While the design of elevated storage for any community requires individual study it is often helpful to make comparisons with other cities as aids and checks in design. In making such comparisons attention must be given to whether the demands are controlled by metering and in what measure they are so controlled. A graph pictures present day estimated costs of elevated tanks of various capacities on 100 foot towers complete with foundations. Larger tanks are more economical on a per gallon cost basis for the larger communities. In choosing the size of elevated storage it is often economically advisable to use a size larger than the expected requirements because the larger tank will provide additional storage, better service and lowered insurance rates at relatively small additional cost.

"Life Stream" was the title of a public relations sound film shown through courtesy of M. R. Hatcher, Director of Water, Kansas City, Mo.

This film takes the observer through the several steps in the procurement, purification and distribution of Kansas City's water supply. It has been used as a means of informing the public regarding the preparation of the most vital products entering into daily living.

"Modern Developments in the Design and Construction of Water Treatment Plants." Professor E. L. Lium, University of North Dakota, Grand Forks, N.D.

The demand of the general public for an improved water supply includes very wide adoption of softening. A more thorough knowledge of the chemistry of the process and its application to water treatment has required that the design of modern softening plants be considerably different from the old conventional plant. Instead of the old type of plain sedimentation basin we find the modern streamlined clarifiers with combination units in which mixing, coagulation, sedimentation and sludge removal all take place in the same container.

Conditioning of water for filtration has always been important and is still a controlling factor in the design of water treatment plants. The problem of sludge disposal in the softening process is particularly difficult under some circumstances. Some plants are using vacuum filters for drying and disposing of the dried sludge. A very few plants are recalcining for reuse in the softening process. Since there is always an excess, consideration should be given to the sale of such excess lime. Since the original cost of a recalcining plant will be relatively high many plants will hesitate to undertake recalcining until more experience is accumulated elsewhere.

Where river levels vary pronouncedly during the year the cost of providing continuous raw water pumpage by means of the conventional turbine deep well pump and intake pump house becomes very high. The submerged pump can be used here.

Storage of chemicals above the feeders increases the cost of a plant. Some thought has been given to the construction of cheaper storage structures at ground level by using mechanical means to take the chemicals to the dry feeders as the demand requires. The matter of purchasing chemicals in carload lots also enters into these considerations.

The use of indicator mechanisms such as the constant recording and integrating pH mechanism is coming into use and is being included in many plant designs. Cost advantages in construction may be found by substituting steel for reinforced concrete or in other instances reinforced concrete for brick. Modern design and construction requires close contact between the manufacturers of equipment, the design engineers and the operators to effect the best solution of each problem of water treatment.

"Planned Maintenance of Water Works." Alfred Schroeder, City Architect, St. Paul, Minn., Edgar W. Johnson, Water Works Engr., Minneapolis, Minn., R. M. Jenson, Supt. of Water, Grand Forks, N.D.

By **Alfred Schroeder,** St. Paul.

A Water Works Department must be prepared to carry on repairs and maintenance work, often at a particular instant when it cannot be postponed. This requires that an ample stock of parts, repair tools and equipment be on hand and available at every instant of the day and night. Cooperation with the Purchasing Department is necessary in order to secure parts and equipment so that the expected life of the repaired equipment may be as long as possible. In order to avoid excessive kinds of parts and materials it is often wise to standardize on certain types of valves and other equipment. Care should be given in stocking of parts so that the number of each item on hand be somewhat in proportion to the expected demand for them. A carefully worked out inventory record is desirable. It is also a good thing to standardize the types of grease and oil. A card file showing the necessary data regarding the frequency of greasing, changing oil, etc., is valuable.

By **Edgar W. Johnson**
Minneapolis.

The maintenance work of the Water Works Department of the City of Minneapolis, is divided into three branches: 1. The Fridley Mainten-

Mr. & Mrs. John Pray
Mg'r. Munic. Utilities
Ft. Dodge, Ia.

Mr. & Mrs. "Bill" Hurst
City Engineer
Winnipeg

Mr. & Mrs. L. R. Howson
Consulting Engineer
Chicago

Mr. & Mrs. H. G. Tischer
Mgr. Water & Sewage Wks.
Duluth, Minn.

Mr. & Mrs. N. S. Bubbis
Eng'r. Water & Sewage Wks.
Winnipeg

ance Shop, which is responsible for the maintenance of the physical plants including filtration plants, softening plant, pumping stations, buildings, equipment, pumps, etc. This is also the headquarters for all repairs except those done in the field and for the various craftsmen assigned to this work. A crew of electricians is available for 24 hour service. 2. The Street Service Department which maintains the distribution system and all its parts such as hydrants, gates and gate chambers. They are responsible for repairing all leaks in the distribution system. One crew services all large gates by regular and frequent operation of same, some on a quarterly basis and some as frequently as once or twice a month. A crew is always available for service 24 hours a day. 3. The Meter Shop. In this branch the meters are removed, cleaned, repaired, tested and set. Meters are pulled at the request of the owner or because of failure to operate properly as observed by the meter reader.

By **R. M. Jenson,** Grand Forks.

Mr. Jenson spoke of the problems of a small plant where part of the work may be carried on by less experienced men than are available in a larger plant. He spoke of the care that needs to be used in the operation and maintenance of plant equipment and referred to a plan of posting instructions near the various pieces of equipment giving details as to maintenance, greasing and procedure in case of emergency.

"The Use of Chlorine Dioxide in Water Treatment." L. H. Coult, Chemist, Fairmont, Minn., Wallace Johnson, Water Supt., Huron, S. D. Mr. Coult was unable to attend but his paper was made available.

The water supply of Fairmont, Minn., is taken from a chain of shallow lakes none of which exceed 14 feet in depth. Because of the relatively high temperatures in summertime there are prolific growths of a great variety of microorganisms. Growths of algae are controlled by periodic copper sulphate treatment. Softening is carried out by the lime soda process in a conventional revolving paddle type mixing basin and is followed by primary clarification, carbonation, secondary clarification and filtration. Various types of taste and odor control treatment such as breakpoint chlorination, activated carbon, copper sulphate, ammonia and chlorine dioxide have been used. These may be applied in the presoftening basin or the influent of either clarification basin or the filter influent. Ammonia and chlorine may also be applied to the filter effluent. High rate pre-chlorination at times results in a very disagreeable bitter taste. In order to avoid this chlorine residuals must not be allowed to drop *below* 5 parts per million. At times a bitter taste develops in the distribution system that was not noticeable in the plant. Chlorine was applied to the raw water in dosages ranging from 10 to 30 parts per million giving free chlorine residuals through the filters in the range of 5 to 10 parts per million after which ammonia was added. Carbon has also been used.

Experiments with chlorine dioxide began in April, 1947. The results with small dosages were good but as the organic content of the water increased during the summer the results were questionable even with much higher dosages and in spite of change in the point of application. The first treatment with chlorine dioxide involved the use of two pounds of sodium chlorite per million gallons in conjunction with a pre-chlorine dose of 11 parts per million. The chlorine dioxide was applied to the filter influent. Later the pre-chlorine treatment was reduced to slightly under 5 parts per million and the sodium chlorite raised to 4 pounds per million. Results seemed to be good as long as the residuals were not *below* one part per million. The application of chlorine dioxide was then changed to the influent of the second clarifier and later to the softening basin effluent. The character of the raw water is such that no standard of treatment seems to be satisfactory for all conditions. Best results seemed to come with a treatment of about 10 pounds per million of sodium chlorite, the chlorine dioxide being applied at the softening chamber effluent immediately prior to the application of ammonia. The author believes chlorine dioxide to be most effective if applied to water having a high pH and points out the need for a satisfactory method of measuring residual chlorine dioxide.

Discussion by **Wallace Johnson,** Huron, S.D.

The City of Huron, South Dakota, gets its water supply from the James River supplemented by a well supply. Taste and odor problems have been severe over a long period. Chlorine dioxide treatment was first used in February, 1948. Pre-chlorination was applied to the mixing tank and the chlorine dioxide was applied to the filter effluent. Very good uniform results have been obtained by the use of from 1 to 1½ parts per million. Carbon is not now being used. This has proved a satisfactory and economical treatment. Discussion of the experience at Huron brought out favorable experiences at a west Canadian plant.

"Public and Employee Relations," A. J. Taunton, Deputy City Engineer, Winnipeg. Discussion by Leonard N. Thompson, General Manager, St. Paul Water Department, St. Paul, Minn.

Mr. Taunton spoke of recent legislation concerning collective bargaining, which to be successful must be conducted by men of good will with open minds who are willing to listen to an appeal to reason. He suggested that the process of negotiation should begin with proposals and not demands, that the parties avoid taking an initial public stand for or against

L. I. Birdsall Gen'l. Chem. Co. Chicago* | *Wm. P. Tarbell* City Engr. Fargo, N.D.* | *Ora. C. Ayliffe Supt. of Water Fargo, N.D.* | *Alfred Ross Sup't. Sewerage Huron, S.D.* | *A. M. Kircher* Cons. Eng'r. Mankato, Minn.* | *Ole Forsberg* Oliver Iron Mines Hibbing, Minn.* | *C. C. Ludwig League Minn. Munic. Minneapolis*

*(*Past Chairmen of the Minn. Section)*

Programmers

G. J. Schroepfer, Univ. Minn., Minneapolis | *Wallace Johnson, Supt. of Water, Huron, S.D.* | *L. R. Howson, Cons. Engr., Chicago* | *N. S. Bubbis, Engr. Water & Sw'g., Winnipeg* | *E. W. Bennison, Edw. E. Johnson Co., St. Paul*

proposals in advance of negotiations, that strike votes should not be taken in advance of negotiations, and that both parties should have plenty of alternative proposals and be prepared to compromise. He spoke of the part played by conciliation officers as provided by law and referred to labor relations acts now in force in the Dominion of Canada and in the Province of Manitoba.

In 1945 a five member commission was appointed to make a survey of rates and classifications in the whole Winnipeg municipal service exclusive of the police force. Reports were heard from union leaders, employers representatives, department heads and individual employees. Every position was reclassified and rerated. The Wage Service Board, as it was designated, made recommendations regarding working conditions, hours of work and other matters affecting the service and welfare of the employees. The report of this Board was adopted by the City Council. A recommendation was also adopted that an employer-employee advisory board be constituted for the purpose of investigating complaints and advising the City Council on all matters relating to employment. The speaker urged that because of the nature of the service given there should be no strikes by city employees. He stated that while consideration should be given to seniority it should only be considered in combination for merit and talent of the individuals considered.

Discussion by **Leonard Thompson,** St. Paul.

Mr. Thompson said that not one of us, in spite of what we may think of unions on the basis of their present strength and actions, would care to revert to the days of unorganized labor. To a considerable degree management forced the organization of labor and broadly speaking the results have been beneficial to both labor and management. Labor has become as much a part of big business as management, and the leveling of power by labor and management is now in process as public opinion and experience demand the application of equitable regulatory laws to both. Strikes among public employees are generally frowned upon, and the right to strike should be held secondary to the general public interest.

"Disinfecting Water Mains." Arthur F. Mellen, Supt. of Water Treatment, Minneapolis, Minn. Discussion by W. W. Towne, Director Div. of Sanitary Engineering, So. Dak. Board of Health and Jerome H. Svore, Dir. Div. San. Engr., No. Dak. Bd. of Health.

The basis for discussion was the report "A Procedure for Disinfecting Water Mains" adopted by the Board of Directors of the A.W.W.A. and published in the *Journal* of February, 1948, page 131. It was planned to present a panel discussion but because of the limitations of time this was not possible. Mr. Towne reviewed an article entitled "Main Disinfection" by Cecil K. Calvert, who was Chairman of the committee which made the report referred to. He stated that careful attention must be given to every item although it may appear small, which will safeguard public health in the case of new installations or repairs in the distribution system. He quoted from Mr. Calvert's comments regarding the difficulties of reaching an agreement in making the report and some of the considerations which entered into the adoption of certain items in the report. Mr. Svore discussed the contamination of mains during construction and repairs and cited seven authenticated instances of water borne outbreaks involving 1,395 cases and several deaths. Mr. Mellen referred briefly to each section of the procedure in order, emphasizing the most important items, pointing out certain limitations and precautions and also where the recommended practice differs from present common practice. In addition to the recommended procedure for the disinfection of joint packing material he called attention to an alternate procedure for the disinfection of jute with saturated lime water, based on a paper by S. T. Anderson in the *A.W.W.A. Journal*, April, 1940, page 648.

"The Design and Installation of Larger Meters." E. W. R. Butler, Manager, Western Canadian Div., Bailey Meter Co.

The speaker referred to the two broad groups of meters; namely, the quantity meters and the rate of flow meters. After naming seven different types of quantity meters he took up in detail the design of flow meters and discussed standard heads, characteristic pressure variations, pressure loss, flow formula and straight pipe requirements. For convenience in presenting the piping requirements standards published by the A.G.A.-A.S.M.E. report, eight piping groups or schedules have been set up. The first seven schedules cover the use of orifices and flow nozzles while the eighth applies only to Venturi tubes. Each schedule except the eighth shows the minimum length of straight pipe required for the piping arrangement both on the inlet and on the outlet sides for orifices or flow nozzles. Alternately it also shows the length of straight pipe required on the inlet side when straightening vanes must be used in lieu of the longer runs of straight pipe.

The total problem in flow measurement resolves itself into two parts (a) the primary element (b) the recording and totalizing element. He stated that the best meter is a sturdy well designed instrument which achieves its purposes without the necessity of cams, excessive levers, etc. which of course cause friction. He then discussed the connecting piping, and the overall accuracy of the installation. Mr. Butler presented eight unusually good illustrations.

W. W. Towne, State San. Engr., Pierre, S.D. | *E. M. Grime, Chemical Engr., St. Paul* | *E. P. Macdonald, Elec. Rust-Prfg., Chicago* | *J. H. Svore, State San. Engr., Bismarck, N.D.* | *Wm. Yegen, Supt. of Filtr., Bismarck, N.D.*

CHART FOR DETERMINING THE AREA OF ANY RING OR CONCENTRIC CIRCLE

Only two dimensions are necessary to determine the area of any ring—the width of the ring, W, as shown in the sketch, and the distance D, also shown in the sketch. But notice carefully that the distance D is *not* the outside diameter, nor is it the inside diameter. It is the distance from the inside edge to the farthest outside edge.

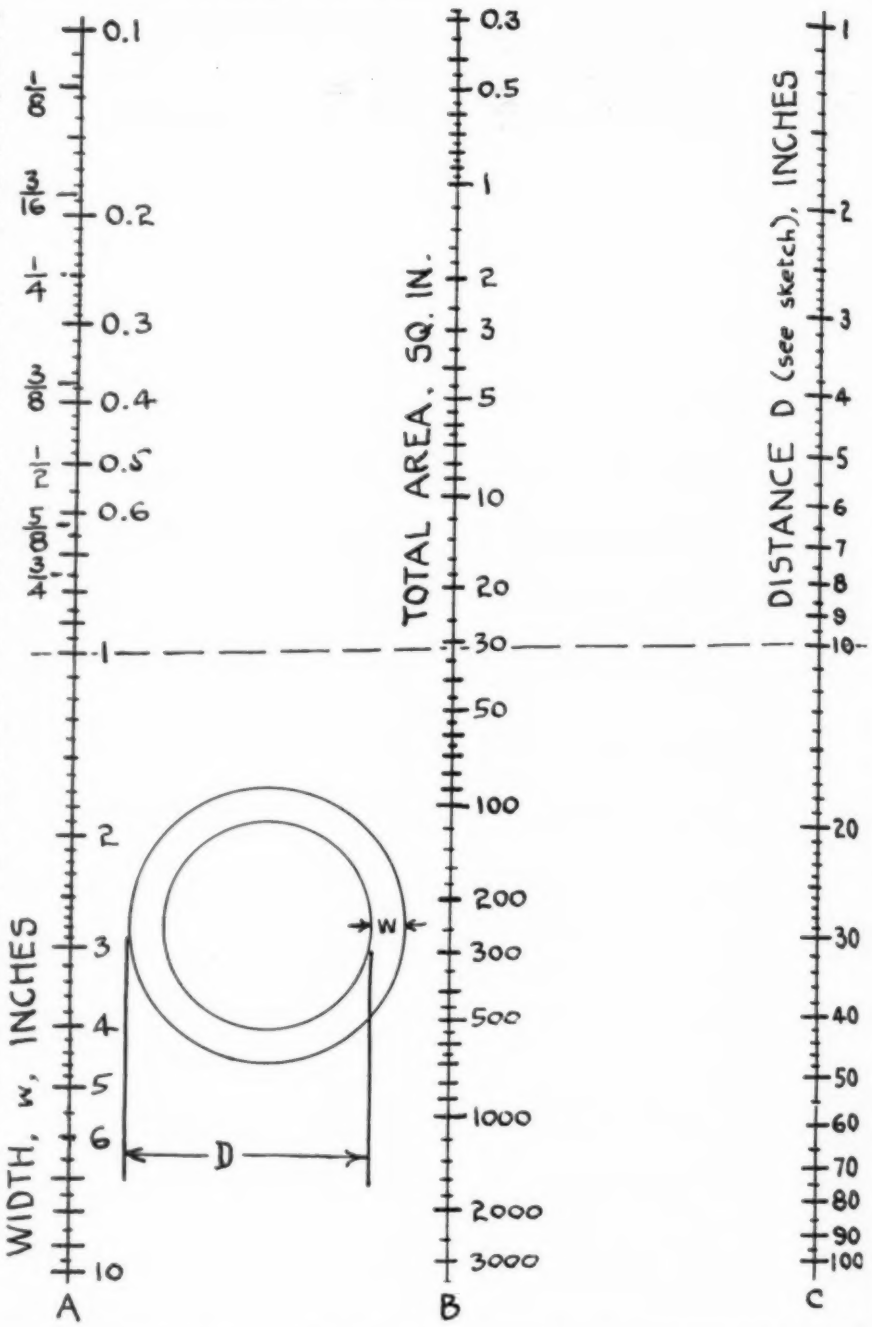
To use the chart simply run a straight line through the width W in column A, and the distance D in column C, and the intersection with column B instantly gives the area of the ring.

Thus, for example, the dotted line drawn across the chart shows that if the width W is one inch and if the distance D is 10 inches, the area is a little over 30 inches. Estimating with the eye and reading the scale in the same way that you read a thermometer, it is evident that the area is very close to 31 sq. in.

If the figures on the chart are not large enough to take care of your problem, simply add ciphers in this way: For example, if the width W is 100 inches and the distance D is 1,000 inches, the same dotted line will solve the problem. Two ciphers are added in column A and two in column C, making a total of four ciphers. Therefore, simply add four ciphers to the result in column B. The answer is 310,000 sq. in.

Similarly, if the figures on the chart are too large, shift the decimal point over to the *left* in columns A and C. Then in the "answer" shift the decimal point to the left as many digits as shifted to the left in column A plus digits shifted in C. For example, if W is .01 in. and D is 0.1 in., the area is 0.0031 sq. in.

By W. F. Schaphorst, M.E.
Newark, N.J.



E. C. Garthe Heads Land and Air Carrier Section U.S.P.H.S.

The appointment of Sanitary Engineer Edmund C. Garthe to head the Land and Air Carrier Section of the Sanitary Engineering Division of the Public Health Service was announced recently. Mr. Garthe succeeds Sanitary Engineer Director H. Norman Old who has been assigned to the Bureau of Medical Services. Mr. Garthe has been a member of the Public Health Service staff since 1936 when he joined as a Junior Sanitary Engineer of the New York district office. In 1944 Garthe was appointed District Engineer of the New York District and entered the Regular Corps as Sanitary Engineer in August 1945, after which he was transferred to the Chicago District as District Engineer.

The Land and Air Carrier Section is concerned with the compliance of common carriers with the requirements of the Interstate Quarantine Regulations regarding the sanitary quality of food and drinking water served on conveyances operating in interstate traffic.

Allegheny Co. Authority Goes Into Water Business

On Aug. 24, the county commissioners of Allegheny County in Pennsylvania voted to give the right to the Allegheny County Sanitary Authority to "obtain, maintain, and operate any and all water supplies in the county."

This action expands the function of the Authority and should make the implementation of the Authority's sewage disposal problems much quicker and easier.

SHALL FLUORIDE BE ADDED TO PUBLIC WATER SUPPLIES?*

A Summary of Current Data and Opinions on This Problem in Mass Medication

by

HARRY A. FABER†
Research Chemist
THE CHLORINE INSTITUTE, INC.
NEW YORK, N.Y.

MAN can exist on the earth because nature supplies him with water, a basic necessity of all life. The water which nature provides, however, is not *pure* water. Since it is a universal solvent, water contains dissolved gases and solids, suspended matter and minute living organisms. Pure water would be a laboratory curiosity, very difficult to provide and even more difficult to keep.

Simple observation may reveal that a natural water contains impurities: as taste, odor, color, turbidity, and hardness (soap consuming power). But the composition and amount of impurities can be determined only by chemical, physical, bacterial, and microscopical tests. Routine tests of this nature are made to control the safety of municipal water supplies or the usefulness of industrial water supplies.

The total impurities in water are far more numerous than those disclosed by routine tests. For example, natural water contains many chemical substances which would be identified only by elaborate and costly analyses. The chemical substances in water may be broadly classified into three types: (1) Those which are desirable constituents, (2) those which are undesirable constituents, and (3) those which are of no known significance.

It is now established that at least one chemical constituent of water has a Dr. Jekyll and Mr. Hyde personality: it may be either beneficial or detrimental, depending upon the amount present in the water. This constituent is the fluoride ion.

Fluoride Is Bad— Remove It From Water

Near the beginning of this century, the condition of teeth now termed mottled enamel was noted and described[1]. This defect is most pronounced in the permanent teeth and is produced during the period of tooth formation, largely during the first eighty years. In mild cases, the enamel has a dull, chalky-white appearance, in contrast to the smooth and translucent character of normal enamel. In more severe cases, the defective enamel becomes pigmented and irregular splotches or bands develop on the surface; these range in color from yellow and light brown to black. In severe cases, the enamel surface appears corroded.

Considerable research was devoted to the problem of mottled enamel, but thirty years elapsed before its cause was correctly determined. The existence of fluoride in drinking water was discovered in 1931, and it was identified as the causative agent of mottled enamel in the same year[2].

Since that time, many investigators have shown the widespread areas in which fluorosis, or mottled enamel, is prevalent. It has been definitely

The Author

In the matter of the addition of fluorides to water, it would seem wise to adopt a terminology consistent with the actual practice involved. The reader's attention is called to the fact that in no instance is fluorine added to the water. In all cases, it is the addition of the fluoride ion which is practiced. Therefore this treatment should be known as *fluoridation*, not fluorination, and Mr. Faber's terminology follows that precept. —The Editors

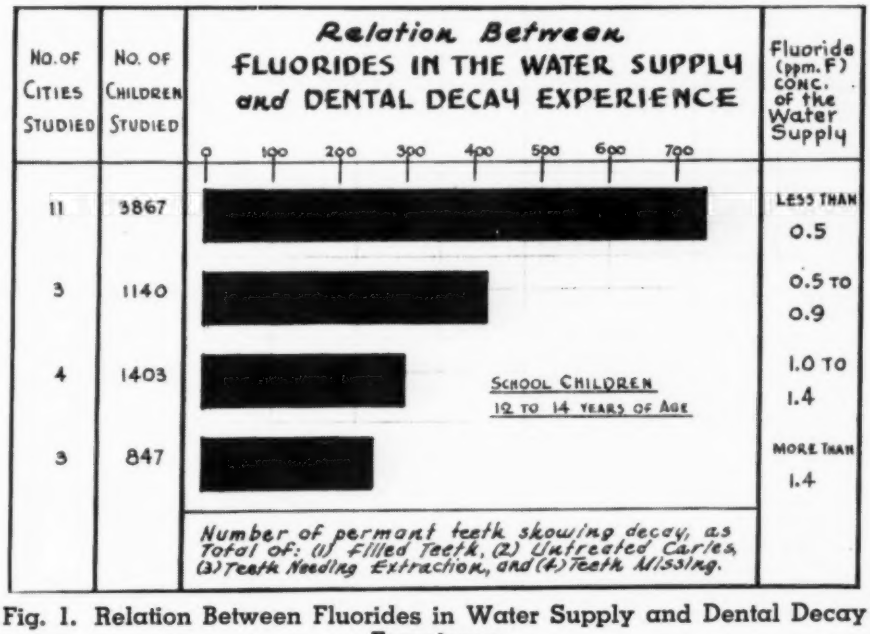


Fig. 1. Relation Between Fluorides in Water Supply and Dental Decay Experience

(Chart redrawn from article by H. Trendly Dean[3])

*Presented at the Annual Conference of the Pennsylvania Water Works Operators' Association, and here published by permission.

†Editorial Associate, *Water & Sewage Works.*

Comparative
LOSS OF TEETH AND DENTAL DECAY EXPERIENCE
by Age Groups
MADISON
0.05 FLUORINE P.P.M.
COLORADO SPRINGS
2.6 FLUORINE P.P.M.
NUMBER EXAMINED
NUMBER WITH NO DECAY
DECAYED AND FILLED TEETH
EXTRACTED TEETH
AVERAGE NO. DECAYED MISSING AND FILLED TEETH PER PERSON
AVERAGE NO. EXTRACTED TEETH PER PERSON
AGES 10-14
MADISON 840 33 5538 376 7.04 0.448
COLORADO SPRINGS 60 40 66 4 1.10 0.067
6 TIMES AS MUCH DECAY EXPERIENCED PER PERSON
7 TIMES AS MANY EXTRACTED TEETH PER PERSON
AGES 15-19
MADISON 224 4 2446 323 12.36 1.442
COLORADO SPRINGS 167 78 277 11 1.72 0.065
7 TIMES AS MUCH DECAY EXPERIENCED PER PERSON
22 TIMES AS MANY EXTRACTED TEETH PER PERSON
AGES 20-24
MADISON 158 0 2182 509 17.03 3.222
COLORADO SPRINGS 101 33 254 9 2.60 0.089
7 TIMES AS MUCH DECAY EXPERIENCED PER PERSON
36 TIMES AS MANY EXTRACTED TEETH PER PERSON
AGES 25-29
MADISON 106 0 1336 569 17.97 5.367
COLORADO SPRINGS 93 18 331 23 3.80 0.246
5 TIMES AS MUCH DECAY EXPERIENCED PER PERSON
22 TIMES AS MANY EXTRACTED TEETH PER PERSON
AGES 30-34
MADISON 82 0 1174 477 20.13 5.817
COLORADO SPRINGS 46 10 159 18 3.84 0.391
5 TIMES AS MUCH DECAY EXPERIENCED PER PERSON
15 TIMES AS MANY EXTRACTED TEETH PER PERSON
AGES 35-39
MADISON 85 0 1135 5.77 2014 6.788
COLORADO SPRINGS 37 6 119 11 3.51 0.298
6 TIMES AS MUCH DECAY EXPERIENCED PER PERSON
23 TIMES AS MANY EXTRACTED TEETH PER PERSON
AGES 40 and ABOVE
MADISON 251 0 2310 2976 2106 11.857
COLORADO SPRINGS 64 6 379 24 6.29 0.375
3 TIMES AS MUCH DECAY EXPERIENCED PER PERSON
32 TIMES AS MANY EXTRACTED TEETH PER PERSON
* All cases

Fig. 2. Comparative Loss of Teeth and Dental Decay Experience by Age Groups, with and without Fluoride in Water

(Chart copied from article by Frederick S. McKay[8])

shown that a fluoride concentration of more than 1.0 ppm. in drinking water will cause mottled enamel in the teeth of children consuming the water. There is no significant fluorosis or mottling of tooth enamel when the water contains 1.0 ppm. or less of fluoride. When the water contains concentrations higher than 1.0 ppm., mottling is progressively more severe; and above 6.0 ppm. almost every child will be affected[1].

It is reported that more than one million persons in some 500 communities of the United States use water which contains excessive concentrations of fluoride (over 1.5 ppm.). Much study has been given to the development of methods for treating water to remove fluorides. There is a need for such methods, because it is impossible or impractical for the majority of these communities to change the source of water supply to one having a satisfactory fluoride concentration.

The details of methods so far developed for the removal of fluorides from water have been described in the literature[7]. The principles involved in these methods are either: ion exchange, adsorption, or the formation of complex salts. In comparison with the usual methods of water treatment, all methods of fluoride removal are low in efficiency and high in cost. On the basis of reducing a fluoride ion concentration of 6.0 ppm. down to 1.0 ppm., the costs of various methods considered applicable to the treatment of municipal water supplies are estimated to range from $275 to $90 per million gallons.

A water treatment plant specifically designed for fluoride removal has been operated in one community since 1937. The material employed, granular tricalcium phosphate, removes fluoride by ion exchange. When the removal capacity of the contact filters containing this material is exhausted, they can be regenerated with a one per cent solution of caustic soda. The fluoride content of the raw water in this plant is reported to average 8.3 ppm., and that of the treated effluent to average 0.6 ppm. Chemical costs for fluoride removal at this plant, in 1934, totaled about $130 per million gallons.

It is clear that the fluoride removal methods now available are expensive to install and to operate. Only when more economical methods are developed, will such treatment be widely used for public water supplies containing excessive concentrations of fluoride. Until that time, mottled enamel will remain a dental hazard to a large population in many communities of this country.

Fluoride Is Good— Add It To Water

The undesirable effects of water containing excessive amounts of fluoride are now well established. Evidence demonstrates clearly that the concentration of fluoride in a water is directly related to the severity of dental fluorisis (mottled enamel) which is produced. Early investigators of this condition paid little or no attention to those waters containing 1.0 ppm. or less of fluorides, since they were found not to produce mottled enamel.

Beginning in 1938, knowledge of great practical significance developed from new studies. It was found that small concentrations of fluoride in water contribute to dental health. As a result of much careful investigation, it was shown that when the public water supply contains about 1.0 ppm. of fluoride, dental caries (tooth decay) rates are at a minimum[3]. Fortunately, this concentration of fluoride does not have undesirable effects.

The first studies correlating the incidence of dental decay with the fluoride content of the water supply are credited to H. T. Dean[6]. In selecting communities for comparative studies, he was careful to control all variable factors with the exception of the fluoride content of the water supply. He took into consideration such variables as climate, latitude, sunshine, economic status, diet, age, sex,

color, and place of birth. The results of his surveys indicate definitely the existence of an inverse ratio between dental caries rate and the fluoride concentration of the water supply.

A paper published by Dean in 1938 revealed that in various areas of Western and Middle Western United States (that is, where the fluoride concentration of the water is high) there were more caries-free children than in communities where the water supply contained little or no fluoride. In that paper he suggested the possibility of controlling dental decay by using a water supply containing approximately 1.0 ppm. of fluoride.

In 1939, Dean and others reported a study of four Illinois cities. They found that where the water contained have provided an intermediate degree of dental protection.

In 1943, a very comprehensive study by Dean was published[60]. This summarized the findings of an extensive study of the dental decay experience of more than 7,000 children aged from 12 to 14 years. The results, when correlated with the concentration of fluorine in the water, show the following:

Dental Decay Experience per 100 Children	Fluorides in the Water Supply
740	Less than 0.5 ppm.
416	0.5 to 0.9 ppm.
294	1.0 to 1.4 ppm.
244	More than 1.4 ppm.

These data are illustrated in Fig. 1. The differences in dental decay experience are so striking, and the rate of decay is so clearly in an inverse ratio to the fluoride content of the water that it seems evident the presence of this constituent is the preventive factor.

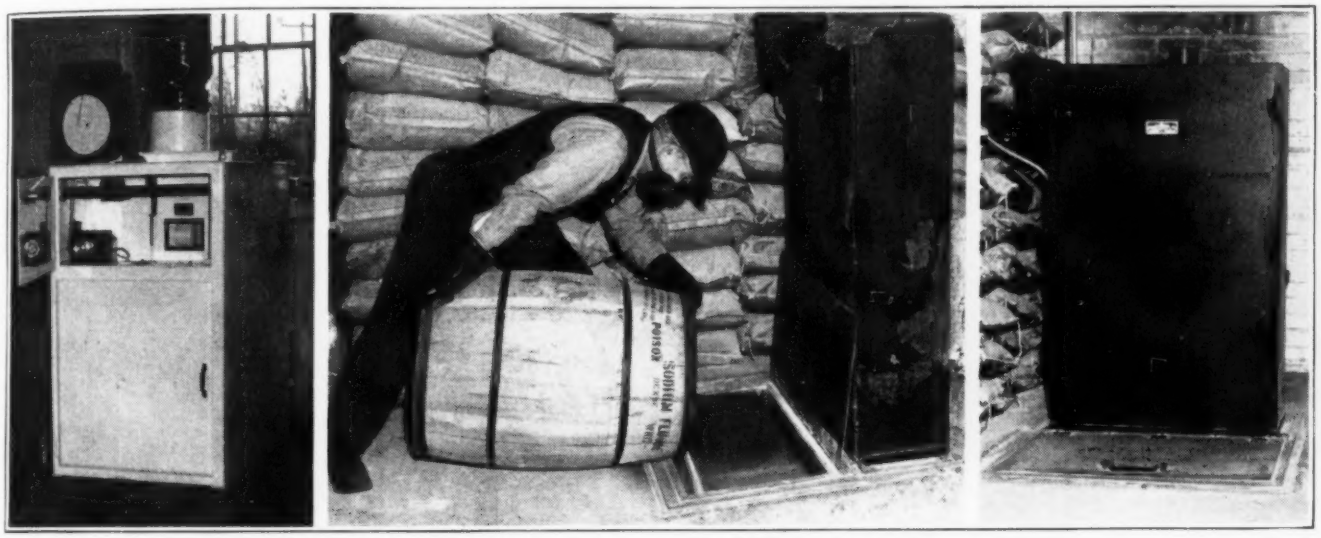
Experience With Decay and Extraction of Teeth.

MADISON, WISC., LOW FLUORIDE WATER (0.05 PPM.) COLORADO SPRINGS, COLO., HIGH FLUORIDE WATER (2.6 PPM.)

Ages	Number of Times as much decay	Number of Times extracted teeth
10-14	6	7
15-19	7	22
20-24	7	36
25-29	5	22
30-34	5	15
35-40	6	23
41-+	3	32

(Madison shows several times as much decay per person and several times as many extracted teeth per person)

In a contemporary review of this subject, Arnold[60] states: "A logical



Fluoridation Equipment at Sheboygan, Wis.

Omega Precision Gravimetric Feeder — *Precautions in handling sodium fluoride include dust mask, rubber gloves, ventilator, and dust filler on feeder hopper.* — *Hopper dust filter takes care of dust in filling*

1.8 ppm. and 1.7 ppm. of fluorides (Galesburg and Monmouth), the number of permanent teeth showing decay was 201 and 205 per 100 children. Where the water contained only 0.2 ppm. (Macomb and Quincy), the rates were 401 and 633 per 100 children.

The results of studies made to determine the lowest concentrations of fluorine effective in reducing tooth decay were published by Dean and others in 1941. Eight suburban cities around Chicago were selected. Data were studied for four cities having respectively 1.8, 1.3 and 1.2 ppm. of fluoride; one city having 0.5 ppm.; and three cities having fluorine-free water. The dental decay experience of children 12 to 14 years of age in the first four cities was found to be markedly less than that in the cities having fluorine-free water. The water in the city having 0.5 ppm. fluoride seems to

Up to the present time, evidence of the action of fluoride has been derived almost wholly from data on children. There has been little information as to the dental condition of adults who had acquired various degrees of fluorosis of teeth during childhood. In a paper published during 1948, McKay presents evidence that the inhibitory effect of fluorine, once acquired, may be permanent[65]. The significance of rates of tooth decay in one community where the water supply contains 2.6 ppm. fluoride, and in one where it contains 0.05 ppm., is evident in the following summary of his results. These data are illustrated in detail in Fig. 2. The Colorado Springs water supply has a natural fluoride content of 2.6 ppm. This is above the level which does not produce fluorosis (mottled enamel), and it is reported that mild fluorosis is characteristic of those who use this water.

assumption, in view of the evidence so far presented, is that dental caries may be controlled by fluorination of the water supply. The unusually high prevalence of this disease makes it particularly suited to a type of control measure which is on a communal basis and is not dependent on individual volition."

This evidence (that the variation in tooth decay is due to differences in the domestic water supply, specifically to the fluoride content) like most epidemiological evidence, is presumptive in nature. But, in addition to these studies on human beings, there are reports describing laboratory research which indicate that fluoride similarly affects tooth decay in experimental animals. Although epidemiological evidence is presumptive, it may be entirely valid evidence. The adoption of chlorination, in the disinfection of water supplies for the control of

typhoid fever, is based on similar presumptive evidence.

At present, it must be assumed that the addition of fluoride to a water supply will produce the same effects as one naturally containing fluoride. All evidence suggests that it will, but the final answer to this question awaits the results of research studies (full scale application under controlled conditions) now in progress.

Fluoride Treatment Studies Being Made

The first community to undertake fluoride treatment of its water supply is Grand Rapids, Mich., which started such treatment in January, 1945[9]. This study is sponsored by the U.S. Public Health Service, with the cooperation of the Michigan Department of Health and the University of Michigan. The second application was made in a study started a few weeks later, at Newburgh, N.Y., under the direction of the New York State Department of Health. Fluoride treatment is regularly used in at least nine municipal supplies of the U.S. and Canada.

Grand Rapids, Mich.
Newburgh, N.Y.
Midland, Mich.
Sheboygan, Wisc.
Ottawa, Kans.
Evanston, Ill.
Marshall, Tex.
Madison, Wisc.
Brantford, Ont.

There are a number of other communities now planning on the use of fluorides.

Generally this application of fluoride is made under the supervision of the State Department of Health, and is undertaken as a study planned on a 5 to 10 year basis. Dental studies are usually made of children in the community, and another community using similar water low in fluoride content is studied as a control.

In New York State, for example, the neighboring cities of Newburgh and Kingston are participating in the study. Each city has a population of about 30,000, which is fairly similar as to race and economic status. The raw water supplies of the two cities are very much alike in chemical composition, that of Kingston containing about 0.05 ppm. fluoride and that of Newburgh being treated to contain about 1.0 ppm. fluoride. Composite samples are collected daily for fluoride analysis to control the treatment process. A dental examination of all children 5 to 14 years of age was made by the State Health Department at the outset of the study and is to be repeated annually.

The treatment of a water supply with fluoride is a simple procedure. The form of fluoride applied is commercial sodium fluoride. The fluoride content of this salt is such that a dose of 1.0 ppm. fluoride ion requires the addition of 2.2 ppm. of sodium fluoride. That is, approximately 18.4 pounds of pure sodium fluoride must be used in order to provide a dose of 1.0 ppm. fluoride ion.

Sodium fluoride is readily soluble in water and is generally applied by means of a dry feed device. For relatively small volumes of water, the dry feed device must be especially designed to feed accurately at low rates. The sodium fluoride is discharged as fed into a minor flow of water in a dissolving unit, and the solution flows by gravity into the major flow of water. Water under pressure may be treated by using, to apply fluoride solution, one of the small chemical solution pumps designed for feeding hypochloride solutions. At one treatment plant, hydrofluoric acid is reported to be employed as the source of fluoride.

Fluoride Feeder at Grand Rapids, Mich.

(The first installation in America is inspected during Mich. Section A.W.W.A. Meeting)

The test for residual fluoride in water is a relatively simple colorimetric procedure[7], based on the Scott modification of the Sanchis method. The chloride ion does not interfere in this test up to a limit of 500 ppm. Howecer, a free available chlorine residual is reported to interfere in the test for residual fluoride, and methods have been devised to reduce this interference[9]. In order to prevent any loss of added fluoride by coagulation and filtration, the fluoride is added to water following filtration.

Tooth Decay and the Function of Fluoride

As far back as historical records go, it is known that human beings have been subject to dental disease. Tooth decay is mentioned in the most ancient of all known works on medicine, written about 37 centuries B.C., and probably toothache has existed as long as mankind[10]. The control of dental caries is the fundamental problem of modern dentistry. This problem is complicated by the fact that dental enamel, once injured, is incapable of self-repair.

The need for corrective measures is so great that the American dental profession, now grown to approximately 70,000 practitioners, finds that dental caries is developing faster than it can be treated. Of the first 2 million men examined for the army in the second world war, the chief single cause for rejection was dental defects. During 1941, about 500 million dollars was spent for dental services in the U.S. Despite this vast expenditure, these services were rendered to a portion of the population only, the majority of people receiving either no dental services or merely extractions[3].

While progress has been made in explaining how dental caries occurs, the prevention of decay still awaits either new conceptions or further proof of present promising explanations[9]. There have been numerous articles published within the last ten years which began, "We do not know the cause of dental caries." The authors then continued learnedly, but unconvincingly, to lecture the reader on the proper means to assure protection from this disease (cause unknown). The public has been advised to utilize vitamins, lime, phosphates, minerals, chewing gum, quinones, anti-bietics, ammonia, urea, mouth washes, dentifrices, tooth brushing, alkaline diets, protein diets, uncivilized diets, sugar-free diets, or to live an emotionally stable existence[10].

On the basis of research carried out nearly fifty years ago, and supported by recent investigations, the opinion of the American Dental Association appears to be as follows[10]: "Dental caries is caused by acids resulting from the action of micro-organisms on carbohydrates, is characterized by a decalcification of the inorganic portion, and is accompanied or followed by a disintegration of the organic substance of the tooth." Certain bacteria, particularly Lactobacillus acidophilus, have long been considered implicated in causing dental decay. It has been considered that small amounts of fluoride in water suppress the produc-

tion of acid by this organism, though not necessarily inhibiting its growth[12].

It has very recently been reported, however, that the formation of acid from carbohydrates in the mouth is enzymic in nature, and that the reaction is extremely rapid in nature[11]. On this basis, it is obvious that the decay of teeth is not a long, continual, and gradual decalcification, but rather a series of intensive reactions. All of the acid is derived from the carbohydrate left in the mouth, and is not related to the amount swallowed. It appears, therefore, that the control of dental decay depends upon inhibiting the rapid formation of acid.

This can be accomplished by applying a chemical which will inhibit the enzyme activity and thus correspondingly reduce the formation of acid from carbohydrates. At present the only known inhibitor, which is retained for appreciable periods of time, is the fluoride ion. This action is not purely inhibitory, but is also dependent upon a change which is produced in the solubility of the tooth enamel. Any other enzyme inhibitor must be applied during the ingestion of food or immediately thereafter and is, therefore, not practical.

It is for this reason that the application of fluoride to drinking water may be considered a major step in the control of dental caries, because the individual will thus apply an enzyme inhibitor constantly, and with no additional effort on his part. However, the fluoride ion is not considered an ideal inhibitor. It is too toxic to apply in sufficient concentration to stop all acid formation. Thus, only partial inhibiting action can be expected within practical limits of fluoride application. It is quite possible, nevertheless, that a 10 per cent reduction of acid formation will prevent 60 to 90 per cent of dental decay. This is because it is only necessary to slow down the process of acid formation to the extent that the normal neutralizing influences in the mouth can cope with the situation.

Opinion Favoring Fluoridation of Water

It is clearly evident that a concentration of about 1.0 ppm. fluoride, when naturally present in the water supply, does reduce the incidence of tooth decay. The optimal concentration appears to be about 1.0 ppm. since this does accomplish such a reduction but does not produce mottled enamel. Beyond 1.5 to 2.0 ppm. fluoride concentration, mottled enamel may be expected to occur with increasing intensity.

The addition of fluoride to a public water supply has been estimated to produce the following results[12]:

1. Six times as many children having no dental caries experience.
2. A 60 per cent lower rate of tooth decay.
3. A 75 per cent decrease in the loss of the first permanent molar.
4. A 90 per cent reduction in tooth surface caries in the upper anterior teeth.

Dean has pointed out[3] that if the controlled experimental studies now under way prove successful, and an unusual amount of presumptive evidence indicates that they will, then public water supplies would be classified into three groups (on the basis of fluoride content):

A. Those naturally containing the *optimal* concentration of fluoride and requiring no treatment.

B. Those containing an *excessive* concentration of fluoride and requiring removal of the excess in order to protect the community against mottled enamel.

C. Those containing a *deficient* concentration of fluoride and requiring addition of fluoride to provide the optimal concentration in order to reduce dental caries attack.

Preliminary reports have been made on the control of caries accomplished by adding fluoride to a water supply. After one year of such treatment at a State Training School in Connecticut, Erlenbach and Tracy found[13] that there was 30 per cent less tooth decay in children using the water treated with fluoride than in a control group. After two years of such treatment, the authors concluded that: "The evidence presented thus far demonstrates quite conclusively that artifically added sodium fluoride in a water supply, under the conditions stated, is effective in reducing the incidence of new decay, and that the order of this effectiveness is probably greater than 25 per cent."

The attitude of public health officials with regard to the addition of fluoride to a water supply is an important consideration. Nichols reports[14] that in Madison, Wisc., 103 out of 106 dentists asked the city Common Council to vote that the city supplement the water supply by the addition of fluoride. On the medical side, 154 out of 180 physicians in that city made the same request. Fluoride

Wallace & Tiernan Novadel-Agene Chemical Feeder at Newburgh, N.Y.
(The metal can in the lower right hand corner is used to fill the hopper. When the can is placed on the machine, a slide is pulled and the fluoride enters the hopper without escape of dust.)

treatment is now regularly employed at Madison.

Opinion Against Fluoridation of Water

As with most questions, however, there are two possible points of view concerning the addition of fluoride to water supplies. In 1943, Wolman summarized clearly the responsibilities of public water supply officials in the correction of dental deficiencies[15]. He pointed out that the whole prior history of the treatment of public water supplies has involved the effort to eliminate products from water rather than to introduce new chemical or biological substances.

He emphasized that *in theory* there is no reason why we should not go farther, and process the public water supply not only to remove undesirable material but to add desirable substances in order to improve public health. *In practice*, he suggested that evidence should be accumulated in controlled studies before all the low-fluoride waters in the country should be subjected to the addition of fluoride.

In 1947 Wolman proposed four guiding principles concerning the addition of fluoride to water supplies[16]. These are:

"*Principle 1.* Until the periods of controlled experimentation on water have fully elapsed and the findings on these procedures and their effect have been authoritatively reviewed and assayed by competent medical, dental and public health professionals, the water works official should avoid the use of the public water supply for medication.

"*Principle 2.* Even at that time, practices for treating the diseases of the people in ways other than through the community water supply should be thoroughly evaluated from the professional and the economic standpoints. In general, such alternative practices, inherently more specific in their nature, are to be preferred.

"*Principle 3.* Universal application of chemicals to water for medication should be predicated upon substantial unanimity of opinion by official medical and public health agencies on the efficacy of the treatment proposed.

"*Principle 4.* A natural prerequisite to any procedure for mass medication through the public water supply is complete concurrence between the officials of the water department and those of the health department."

What "alternative practices, inherently more specific in their nature" are known for control of tooth decay? As has already been pointed out[10], many practices have been suggested and investigated without the development of a single more specific means for control of tooth decay. There is, perhaps, one exception—but it may be considered a modification of fluoride treatment.

A relatively simple technique has been developed[17] for the dental profession to apply dilute sodium fluoride solution directly to teeth. This method of treatment is termed a "topical application" and has been studied for more than five years[18]. Each treatment involves four visits to the dentist, but the technique is simple[19]: The first treatment consists of cleaning the teeth and wetting them with sodium fluoride solution; the second, third, and fourth treatments require only the application of sodium fluoride solution. This treatment has been shown to effect a 40 per cent reduction in dental caries. The effect lasts from 3 to 5 years, and it is suggested that the topical application be repeated at ages 3, 7, 10 and 13.

A few investigators do not agree that published studies prove tooth decay is due to fluoride deficiency in the chemical structure of the tooth, or to fluoride deficiency in the water supply[20]. They do not consider that fluoride should be added to water supplies which contain a low concentration.

Others have published studies which show the degree of tooth protection is not alone a problem of environment, that is, the amount of fluoride in the diet[21]. Results of these studies indicate physical constitution to be involved: those children who are protected most are children whose parents exhibit the lowest tendency to be attacked by dental disease.

Some investigators have exhibited concern over the possible toxicity of fluoride in a water supply[9]. The fluoride ion is stored in the body, in the bones, and in the teeth. In fact, fluoride is at yet the only known variable constituent in sound and decayed teeth. But ingested fluoride is excreted in the urine and there is a direct correlation between the fluoride ingested and the fluoride excreted[22].

McClure and Kinser have reported a study of urinary fluoride in specimens from over 1,900 men and boys representing a variety of conditions ranging from fluoride-free to high fluoride waters[23]. A remarkable relationship was observed between urinary fluoride and the fluoride content of the drinking water. Beginning with exposures approximating 0.5 ppm. fluoride, urine specimens show a detectable increase in fluoride. It was established that fluoride excreted in urine continues proportional to fluoride in the water up to about 5.0 ppm. in the local water supply. Thus, cumulative toxic bone fluorosis appears to constitute no public health hazard when the water supply contains 1.0 ppm. fluoride, since it is shown in this study that the metabolism of fluoride is a normal function of the human body.

The concept that a relationship exists between drinking water and the incidence of caries dates back for many years. It was common belief that a deficiency of calcium salts in the tooth was conducive to caries attack, and it was considered by some that this deficiency was the result of a low mineral content in food and water. Much evidence has been presented and studied; it is so contradictory in nature that, so far as water is concerned, some factor other than hardness (calcium content) must be implicated. It is now considered that fluoride must be the important factor[9].

The Answer to the Problem

This discussion provides a summary of current data and opinions with reference to the question: "Shall fluoride be added to public water supplies?" It refers to the studies and reports of many qualified investigators. These studies can be examined in greater detail by those authorities who wish to evaluate the evidence on the basis of particular local conditions. This discussion, therefore, does not propose to answer the question, because no simple answer is possible.

There exists little or no question as to the desirability of adding fluoride in the several full scale *control* studies now under way in several municipal water supplies. These may be considered careful experimental studies, and the results will be very significant. The present question, difficult to answer, concerns the general application of fluoride to any water supply deficient in this constituent. The terminology employed often reflects the point of view of those discussing the problem. The addition of fluoride has been termed mass medication; more favorably, it has been considered supplemental treatment; or, even more attractively, it has been labeled enrichment of the water supply.

No program thus far suggested for the reduction of tooth decay, except the use of waters naturally containing fluoride, has succeeded in delivering any considerable proportion of a mass population into adult life with an aver-

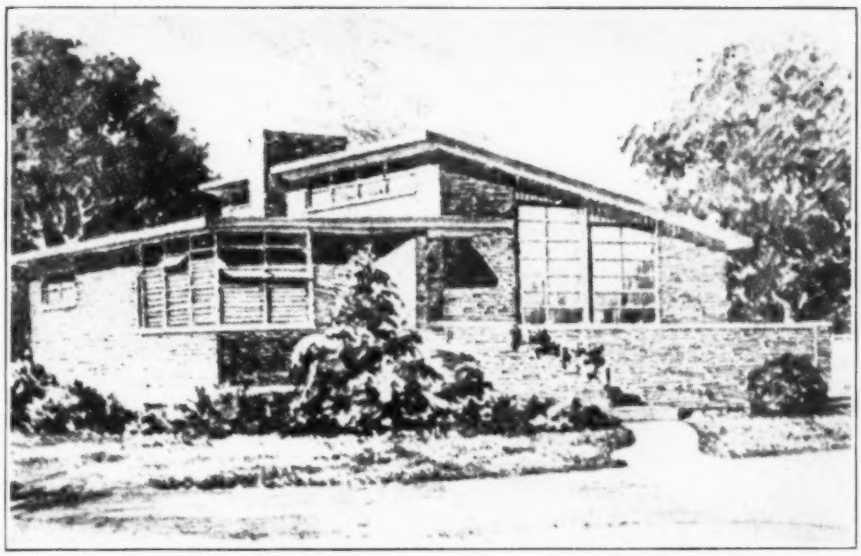
age caries experience rate of about three per person and with a complete absence of decay in approximately one-third of a native population[37]. The problem of tooth decay is a serious one—both from public health and economic considerations.

It is true that excessive fluoride concentrations in water can cause mottled enamel, and some communities using such waters should employ methods for the removal of naturally present fluoride concentrations. It is equally true that the application of fluoride to a public water supply for the reduction of dental decay should not prove a difficult problem. Many supplies are now being treated for clarification, taste and odor control, disinfection, softening, stability, etc., so that chemical feeding equipment and control measures are well established and widely used.

Much of the personnel now responsible for water quality is highly trained. It is obvious, therefore, that should a program for applying fluoride be undertaken, those supplies now receiving treatment under local laboratory control would have no difficulty in applying an additional chemical. Most of these supplies would require only suitable chemical feed equipment to adopt fluoride treatment.

Even though the benefits of the treatment are evident from a public health and financial viewpoint, it is still prudent to consider the legal responsibilities that a community or private utility accepts when it establishes the fluoride treatment of a public water supply. An answer to this question is provided by Faust of the Michigan Department of Health[20]. The opinion of the Attorney General of that State is cited to show that, legally, there is no change in the responsibility of the water utility which applies fluoride to a water supply. Negligence in treatment which results in damage must be shown to establish liability. There would be no method by which a consumer not injured by, but not sympathetic to, the program of fluoride treatment, could prevent such treatment.

There would appear to be no conflict between the fluoride treatment of a public water supply and any individual treatment for the prevention of dental caries. If both the treatment of water supplies and the topical application of fluoride to the teeth were employed, there would be ample need for all the conventional facilities in the form of dental service which can be provided[35]. The studies of the Committee on the Costs of Medical Care of the A.P.H.A. showed that in 1929—at the peak of peacetime prosperity—the individual in the lower half of the population from an economic standpoint had, on the average, one-tenth of a visit to a dentist per year.



New Jersey's First Fluoridation Station

Architect's drawing of Morristown's (N.J.) new chemical treatment station. Fitting architecture for the residential section, the new station will house all chemical treatment equipment for the Morristown supply, and be fully automatic in operation. The new $38,000 station will house chlorination, ammoniation and fluoridation equipment, and represents New Jersey's first water fluoridation plant.

An excellent example of an educational program is that of the city of Sheboygan, Wisconsin, where water department officials assisted in assembling and collecting facts for and against the adoption of fluoridation[26]. The publicity resulted in approval by county medical and dental societies, by the state dental society, and by the City Board of Health. After several sessions of discussion an ordinance was passed by the Common Council. It authorized and directed the City Dept. of Public Health, upon approval of the State Board of Health, to proceed with fluoride treatment, using the facilities of the Water Dept.; the cost to be paid out of the general fund of the city. The State Board of Health approved, and its Bureau of Sanitary Engineering has assisted in fluoridation at Sheboygan. The treatment was started in February, 1946.

It has been stated, with good reason, that the results of "experiment" or controlled studies, at those communities now adding fluoride to their water supplies, will be little more conclusive than the mass of data on those waters naturally containing approximately 1.0 ppm. fluoride. These data have been accumulated during the past fifty years and have been carefully evaluated. There is little doubt that artificially applied fluoride (or mass medication, or supplemental treatment, or enrichment of the water supply) will have an effect differing from that of fluoride naturally present.

Now, while waiting for a little additional data (the results from those communities where fluoride is applied) to be accumulated, a generation of children will grow up with a high rate of tooth decay. After that time, no preventive treatment can be applied to their teeth. It is on this basis that the city of Madison, Wis., decided to employ fluoride treatment while awaiting the results of those controlled studies already under way[34]. The local authorities considered no other method contemplated to be so safe, so adequate, and so economical.

This method of treatment was considered *safe* because not enough water containing 1.0 ppm. fluoride could be consumed to cause the least harmful effect. It was considered *adequate* because every child, regardless of social, economic, or educational status would be able to benefit without effort on the part of his parents. And this method was considered *economical* because it costs only about ten cents per capita per year.

Shall fluoride be added to public water supplies? The answer to this problem will be supplied in part by the results of controlled studies now under way, in part by the results of any other known preventive methods, or future discoveries, and in part by

local considerations. Do the potential benefits of reducing the incidence of tooth decay warrant a new concept of water treatment for immediate adoption? The decision reached will be different for different communities.

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Harvey Jones Passes

Harvey P. Jones died September 24th, after an extended illness. He was 57 years old and the senior partner in the firm of Jones & Henry, Consulting Engineers of Toledo, Ohio. Mr. Jones was born in Sandwich, Ill., and graduated from the engineering school of the University of Michigan in 1916. He was City Sanitary Engineer for Toledo in 1916-1917, and manager of the midwest office of Fuller and McClintock from 1918 to 1926. In 1926 he formed his own consulting firm and practiced under the name of H. P. Jones & Company until 1944 when he entered into partnership with Thomas B. Henry to form the present firm. During the course of his consulting practice he was responsible for studies and planning on many water supply and sewage treatment projects throughout the middle west. Just two weeks before his death plans and specifications were delivered to the City of Toledo covering a $7,500,000 extension to the Toledo Sewage Treatment Plant. The original plant, constructed in 1929-1930, was one of his first large projects. He was a member of the American Society of Civil Engineers, American Water Works Association, Ohio Conference on Sewage Treatment, American Public Health Association, and the Ohio and National Societies of Professional Engineers. He was currently serving as vice-president of the Toledo Section A.S.C.E., was chairman of the Ohio Section of A.W.W.A. in 1943 and national director from Ohio, 1946 to 1948. He served as a member of the Toledo Board of Health from 1940 and as president of that body from 1947 until his resignation on account of ill health in July 1948.

New Pump Station and Reservoir for Waukesha

Waukesha, Wis., with a population of about 20,000 about 18 miles west of Milwaukee, is to have a new pumping station and reservoir. This expansion was planned in 1945, but for obvious reasons—inability to get pumping machinery, etc.—the expansion program is just now getting under way at an estimated cost of about $50,000. There is to be a new deep well, a booster and well pump, a 12 inch meter, and 12 inch main about 1,500 feet in length. Actually the deep well has been completed, work on this being done in 1946, but it could not be put to use for lack of pumping equipment. It took six months to complete the well, at a cost of $21,700, according to a report of the Wisconsin Public Service Commission.

For the construction of the new pump house and reservoir a bid of $41,000 has been received, a much higher figure than contemplated in 1944, when the expansion program was planned. In spite of high costs work has been started, the Public Service Commission having approved the increased cost out of "necessity." This will constitute the fifth pumping station for Waukesha.

Waukesha, long reputed in the middle west for its good water for drinking purposes, ships bottled Waukesha Spring Water to various parts of the country and abroad. There is a story about Waukesha water being so much in demand in 1892, the year of the Columbian Exposition at Chicago, that enterprising Chicagoans planned to pipe the water direct from the springs in Waukesha to the World's Fairgrounds in Chicago, and work is said to have actually been started on the digging of trenches. The work got as far as Big Bend, Wis., a few miles south of Waukesha, when either the money or the spirit gave out and the project was abandoned. The distance for the pipe line would have been about 100 miles.

67TH ANNUAL CONVENTION OF N.E.W.W.A.

570 Attend Meeting in New York Sept. 14-17

THE New England Water Works Association held its 67th Annual Meeting in New York, Sept. 14-17. This was the first time since 1940 that the meeting had been held in New York City. This year's meeting was held at the Hotel Pennsylvania where 52 members of the Water and Sewage Works Manufacturers Assn. had exhibits. These exhibitors were represented by more than 150 persons registered. The meeting was also attended by more than 100 members of the New York Section of A.W.W.A. and a goodly number of wives of N.E.W.W.A. members, and manufacturers' representatives. The total registration was 570.

Presidents

Don. C. Calderwood
Sup't. & Eng'r.
Pennichuck W. Wks.
Nashua, N.H.
(Retiring)

Arthur C. King
Sup't.
Water. Dep't.
Taunton, Mass.
(Incoming)

New Officers

At the close of the session, the appointed tellers announced the result of the ballotting for the ensuing year's officers. They are as follows:

President
Arthur C. King, Supt.
Taunton Water Works
Taunton, Mass.

Vice Presidents
Sidney S. Anthony, Supt.
Augusta Water District
Augusta, Me.

Gordon M. Fair, Dean
Harvard Graduate School
Cambridge, Mass.

Directors
Philip J. Holton, Jr. Chf. Engr.
Water Supply Board
Providence, R.I.

Thomas R. Camp, Cons. Engr.
Camp, Dresser & McKee
Boston, Mass.

Fred. O. A. Almquist, Prin. San. Engr., Conn. State Dept. of Health
Hartford, Conn.

Treasurer
William P. Melley, Supt.
Milton Water Dept.
Milton, Mass.

Secretary
Joseph C. Knox, St. San. Engr.
Mass. Dept. of Health
Boston, Mass.

Editor of Journal
George C. Houser
Brookline, Mass.

Awards

At the annual banquet, President Don C. Calderwood, Supt., Pennichuck Water Works, Nashua, N.H. made the presentation of the Dexter Brackett Memorial Medal to WILLIAM STORRIE, Cons. Engr. Toronto, Ontario, Can., for his paper, "Toronto Water Works Extensions—A General Description of the System with Details of Some Outstanding Features."

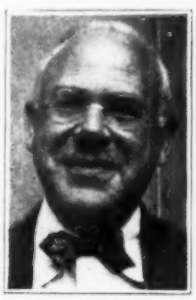
Medalist

William Storrie
Consulting Eng'r.
Toronto, Ont.
(The Dexter Brackett Medal)

Secretary
Joseph C. Knox
State Dep't. Health
Boston, Mass.

Treasurer
Wm. P. Melley
Supt. of Water
Milton, Mass.

Announcement was also made of the award of 25-Year Service Certificates to the following recipients: Roger W. Armstrong, Ch. Engr., City of New York, Board of Water Supply; Walter F. Garland, Supt. Dracut Water Supply Dist., Dracut, Mass.; Augustus V. Graf, Ch. Chem. Engr., St. Louis Water Works, St. Louis, Mo.; A. H. McDonald, Supt., Water Dept., Littleton, Mass.; William P. Melley, Supt., Water Dept., Milton, Mass.; Oren M. Moulton, Engr., Town of Brookline, Mass.; Daniel M. Sullivan, Dep. Comm. P.W.D., Boston, Mass.



Vice-Presidents

Sid. S. Anthony
Sup't. & Eng'r.
Augusta Water Dist.
Augusta, Me.
(Senior)

Prof. Gordon M. Fair
Dean of Engineering
Harvard Univ.
Cambridge, Mass.
(Junior)

Committee Reports

At the annual business session the Secretary, JOSEPH C. KNOX, reported a gain in membership of 33, bringing the total members up to nearly 900, of which 91 are exempt from dues. In spite of increased costs of publishing some 411 pages of text plus 204 pages of advertising in the *Journal*, the *Journal* showed a profit and the funds of the Association showed an increase of more than $300 for the year. The total assets of the organization are now more than $27,600.

Arthur C. King, Chairman, COMMITTEE ON LEGISLATION, reported that the new Connecticut Sales and Use Tax of 2 per cent (1 per cent until 1949) excludes all materials *used and consumed* for water works. In Massachusetts a commission is studying a proposed bill which will hold water works income for water works use only and eliminate transfer of funds to other departments.

Warren G. Scott, Chairman, COMMITTEE ON COMMITTEES, reported that all committees had functioned and that several were submitting progress reports. The Committee to Report on Developments in Water Quality (Arthur D. Weston, Chair.) suggested that this Committee be made a joint-committee with the A.W.W.A. "Committee on Biological and Chemical Problems of Water Distribution Systems." Consideration was given to the establishment of a committee on labor-management relations but due to lack of interest in securing membership for the committee, the idea was given up. A suggestion was made that procedures for water rate increases be made a committee study, but it was decided to promote first one or more papers on the subject.

Mr. Scott's committee still feels that the Association should designate a committee to develop a program of public education in the water supply field either through paid expert service or in some other way. The employment of paid experts appears too costly but the committee believes the work should be undertaken by news letters, and coverage of meetings by or for the press. The employment of a part time water works man to work on this phase was suggested.

Arthur D. Weston, Chairman, COMMITTEE ON RAINFALL AND YIELD OF WATERSHEDS, submitted a report containing data on storage yield relations on the Housatonic River (280 sq. mi.) near Great Barrington, and the Quabog River (151 sq. mi.) at West Brimfield. Both of these studies cover the period from 1912-1944. A study of the tabulation of rainfall for 1941 in New England indicates that the more recent data will have little or no effect on the storage-yield relations published in the 2nd and 3rd progress reports of the committee. (See *J. N.E.W.W.A.*, Vol. LIX, No. 3.)

Wm. C. Stanley, Chair., COMMITTEE ON WATER DISTRIBUTION SAFETY, said that the U.S.P.H.S. Bull. No. 296, "The Manual of Recommended Water Sanitation Practice" included the area of New England in 7½ pages of the report. Stanley suggested need for a review of the 1942

Directors

Thos. R. Camp
Consulting Eng'r.
Boston, Mass.

Phil. J. Holton, Jr.
Chief Eng'r.
Water Board
Providence, R.I.

"A.W.W.A. Tent. Manual of Safe Practice."

Arthur L. Shaw, Chair., COMMITTEE ON SPECIFICATIONS FOR C. I. PIPE & FITTINGS, reported as a member of the A.S.A. Comm. 21, saying that specifications for centrifugal cast pipe (both iron and sand lined molds) were complete. Specifications for smaller fittings are almost complete, while those for larger fittings are slow in development. Consideration is being given to mechanical joints and cement lined pipes but study of tar linings has been abandoned for the present.

Joint committees with A.W.W.A. on Reinforced Concrete Pressure Pipe, Meters, and Hydrants reported progress. Work of the joint committees on C.I. Pipe and Underground Threads for Service Connections is complete and will be reported to A.W.W.A. in January.

Labor Legislation

"RECENT LABOR LEGISLATION AND ITS EFFECT ON PUBLIC UTILITY OPERATIONS" was the title of the paper read by John H. Murdoch, Jr., Vice Pres. and Counsel, Water Works Service Co., Inc., New York, N.Y.

Mr. Murdoch limited his discussion to the Fair Labor Standards Act, the Taft-Hartley Act and two State laws (New Jersey and Pennsylvania).

In discussing the coverage of the Fair Labor Standards Act, the speaker pointed out that under the definitions of the Act, the Federal Government, the States, and all political subdivisions thereof are not employers and therefore are not covered. Inasmuch as more than 85 per cent of all water supply agencies are owned and operated by municipalities, it is obvious that only a "minor segment of a great enterprise is covered" by an act designed to prevent unfair interstate competition. On the other hand, in one way or another, all water supply agencies are affected by the act.

This act sets up a sliding scale of minimum wages, the upper limit of which was reached in October, 1945. The act does not prohibit a long work week, but penalizes an employer for a long work week by requiring payment of overtime at one and one half times the normal rate for all over forty hours. While these provisions regarding overtime appear to be simple, actually they are not when it comes to calculating the overtime, and this point is a long and involved technical procedure in many cases.

The Taft-Hartley Act differs from the previously discussed act in its coverage but it, too, covers only a minor segment of the water works field. As the act is now interpreted, a great majority of privately owned water companies appear to be covered while the municipal supplies are not.

One of the most important features of the Taft-Hartley Act is that *both* management and labor are required to engage in good faith collective bargaining, if the employees have chosen a representative to act for them. These mutual obligations to bargain are new features and constitute an important change from the Wagner Act.

Under the Taft-Hartley Act, the closed shop is no longer legal, but the Act does permit a union shop under which all non-union employees must join the union or face loss of employment. Formal closed shop arrangements in the water works field are unknown, but there have been some union shop agreements.

The Act covers check-off union dues and strikes, but because of the national viewpoint it is doubtful that the 80 day enjoining clause can be invoked by the typical local water plant even though health or safety might be imperiled.

In Pennsylvania, a Public Utility Labor Disputes Act was passed in June, 1947, following the bitter strike

On the Boat Trip Around Manhattan Island

(Left of Skyline)—Mrs. Roger Esty and Mrs. Charlie Crump in a "Hot Dog" eating contest. (Right of Skyline)—Frank Wells of A. P. Smith Co., Thos. Morse of Saugus, Mass. and Norman Adams of Johns-Manville.

of electric employees in Pittsburgh. While neither the companies nor the unions wanted legislation, the public demanded action in its interest. Since that law became effective, there have been no utility strikes.

According to Mr. Murdoch, "the Act seems designed to put a premium on successful collective bargaining and to make it important for all parties to learn how to negotiate with a view to mutually satisfactory settlements." The public, as represented by the State, has determined not to suffer through any public utility strikes.

Another Pennsylvania act makes it illegal to strike in public employment, and this provision will cover employees of municipal water plants.

In New Jersey, in 1947, new laws and amendments to old laws created a new and elaborate scheme for the regulation of public utility employee relations. These laws are still the subject of litigation and the rulings of the higher courts have not yet been made. It is of interest to know that one of the several provisions in these acts makes "a legislative declaration that public utility services are life essentials of the people and that the threat of labor strife in public utility operation is a threat to the welfare and health of the people, and that state regulation of labor relations in the utility field is necessary in the public interest."

Under this law, the Governor may sieze and operate the utility as a State facility, if he determines that public interest, health, and welfare are threatened by a strike in the utility. This new law is important and deserves study by all concerned with employee relations and public service, according to Mr. Murdoch.

Mr. Murdoch closed with the thought that while municipally owned public utilities did not come under the Taft-Hartley Law or the Wagner Act, for that matter, all utilities are or should be revising their employee relations practices and should seek industrial peace by recognizing the newer patterns of thought in spirit even though not having to follow the letter of the law, not designed to cover them.

Neither management nor employees should be allowed to ignore the fact that all utilities serve a public function and the public is affected by their labor relations. A shutdown of a water plant threatens the very life of a community and should never be contemplated nor tolerated. The answer is not simple, but the new labor legislation affects all operations of public utilities by establishing patterns for wages and for collective bargaining. There is also a firm resolve that there shall be no interruption of essential services. Therefore, water utility operators must simply learn to meet these new operating problems.

Stanley M. Dore
Deputy Chief Engr.
Metro. Distr. Comm.
Boston, Mass.
(Program)

"Reg." Hayes
Sales Manager
Hydraulic Devel. Co.
New York
(Entertainment)

Chairmen

Pre-stressed Concrete Pipe

R. M. Doull, Mgr., The Preload Co. of Can. Ltd., Montreal, in an interesting illustrated presentation on "PRE-STRESSED CONCRETE PIPE," outlined the materials and weight-saving advantages of modern pre-stressed concrete pipe. This pipe consists of heavy wire reinforced thin wall pipe poured in molds. This thin pipe after 72 hours of steam curing is wire wound with a No. 6 high tensile steel wire productive of a compression of 114,000 lb./sq.in. After winding, the wire is protected by a Gunite cover coat ¾ in. thick. The completed pipe is steam-cured for 24 hr. and subjected to a hydrostatic pressure test. In an 18 ft. length of 84 in. pipe weighing 16 tons, there is but 500 lb. of steel longitudinal reinforcing and spiral winding wire.

The pipe described is being produced for the new raw-water intake of the City of Montreal and will consist of four lines of the 84 in. pipe extending 2,000 ft. into the St. Lawrence River for the purpose of obtaining a water of more uniform characteristics which can be more economically treated.

Mr. Doull described the plant designed especially for the production of the Montreal pipe and pictured by movies the step by step fabrication of the pipe which is wire wound in a vertical position. Although not to be employed as a pressure pipe each length is subjected to a 50 lb. hydrostatic pressure test and occasional lengths are subjected to 1,000 lb. sandbag loadings while suspended by sling at the middle point and again at 1/3rd length points. A test for rough handling consists of dropping a length 2 ft. onto a knife edge. Testing to failure, the pipe stood up to 15,600 lb./sq.ft. before failing.

The 18 ft. lengths of pipe are to be jointed with steel couplings and jute packed. The four 84 in. lines are to be laid in trench on river bottom and embedded in concrete.

Insurance Problems

Charles C. Goodrich, Insurance, Hartford, Conn., spoke on the subject of "WATER WORKS INSURANCE PROBLEMS," stating that the flood of damage claims, now being made, dictated the need for attention to the problem by water utilities.

Three types of claims are of particular interest to water works men. These are (1) claims by employees, (2) claims by the public, and (3) claims against the public utility. These latter may include claims for bad water, accidents, such as tripping and falling over valve boxes, etc., accidents involving construction work, and catastrophes such as dam failures. Claims by employees are generally settled by compensation. Claims of the public against motor vehicle damage and other third party claims are of lesser interest to utilities.

Mr. Goodrich suggested that self insurance to a certain extent was feasible if done in this manner: The utility to establish the cost of such claims over a period and then to insure for an amount that would cover such claims. The company in this case should employ the services of a claim adjuster. Such a method of operation

On Boat and Bus

(In Center)—President Don. Calderwood and "Madam President" Florence C. (Left of Center)—Mr. and Mrs. "Steve" Taylor of Saco, Me. and New Bedford, Mass. (Right of Center)—Three broad beamed gents: Charlie Crump, Roger Esty and "Pat" Kelly.

does not cover catastrophes and these should be insured against.

This method of insurance against small claims only means that the utility must establish the sense of claim risks among employees. It was also suggested that the utility hold a prize contest to find the risks against which it should insure itself.

Prevention of claims is more important than payment, and a utility should be more particular about the claim service it employs than about the cost of insurance, inasmuch as the cost of claims is about 60 to 80 per cent of the cost of insurance.

Where construction work is being done it is best to have in the contract that the contractor assumes all risks.

In the discussion which followed, DON C. CALDERWOOD, Nashua, N.H., told of a claim for damages resulting from an automobile running into a pile of dirt excavated for main repairs. Testimony of local police that the dirt had been properly lighted with red lanterns just before the accident relieved the utility of payment of the damages.

HARRY U. FULLER, Ch. Engr. Portland Water Dist., asked if the utility could pass all liability on to the contractor. The answer was that in the matter of construction damages the fact that such work is being done by an independent contractor does not relieve the utility of liability if the utility in any manner interferes with or supervises in any way the actual work of the contractor.

STANLEY DORE, Dep. Ch. Engr. Metr. District, Boston, remarked that it could be stipulated in the contract that the contractor is to carry all liability which will not be paid until all claims against the contractor are paid. Mr. Goodrich replied that the best way to eliminate claims is proper safety engineering and the employment of an expert claims adjuster.

While an employee is limited in his claim for injury damages to the amount of workmen's compensation, a non-employee can obtain any amount a jury will award for the same injury incurred in an identical accident, as for example, tripping over a curb box. In a study of claims paid, it appears that most of the monies so paid out for damages are for high amounts. Mr. Goodrich believes in limiting the awards. Another approach to the problem is to extend the limits of government immunity. At the present rate of increase of claims it is to be expected that corporations and utilities will seek some way out, and limiting the awards or extension of immunity may be the answer.

Mfgr's. Ass'n. Brass

Dan. J. Saunders
Sales Mgr.
The Permutit Co.
(President)

Arthur T. Clark
Secy.-Mgr.
W. & S. Wks. Mfgrs. Assn.
(Secy. & Mgr.)

ARTHUR L. SHAW, Cons. Engr., Boston, pointed out that ordinary insurance coverage does not include damage to underground utilities and structures. Mr. Goodrich said that contracts must be drawn to cover all details, use of personal cars, hired trucks, etc., and the contract must contain a contractual liability assumption clause.

Watershed Inspections

Speaking on "WATERSHED INSPECTIONS IN CONNECTICUT, INCLUDING PROBLEMS OF HOUSING DEVELOPMENTS," Frederick O. A. Almquist, Principal Sanitary Engineer, Connecticut State Department of Health, Hartford, said that 96 per cent of the state's population enjoy public water supplies. There are 112 water supplies serving 1,700,000 persons. Of these supplies, 66 are from surface waters, 35 from ground waters, and 13 combined.

Watersheds are inspected at least annually and this is the greatest factor of safety, for the operation of water purification plants increases in efficiency as the coliform content of the raw water goes down. It is desirable to keep domestic sewage out of water supplies particularly where the water purification treatment afforded is simple.

In carrying out an inspection, all houses or farm property within 250 ft. of a stream, or tributary gully are inspected. If any undesirable conditions exist, the department tries to get the resident to correct the condition unless the condition existed before the stream was developed as a water supply.

If the property owner won't cooperate it is possible to issue orders by the local health officer to enforce remedial measures, or the public health council can issue orders, the commissioners of health can hold a hearing, or a utility can obtain an injunction. The latter method is the fastest for producing results.

When and how to make inspections varies according to the situation, but in almost all cases the man who makes the inspection must be a diplomat. Whether the results are recorded on maps or by card index is a matter of personal choice, but, in any case, information should be kept up to date.

In Connecticut, there is no rule regarding animals, except in regard to manure piles and pasturing in low lands near streams. Clothes washing in streams is prohibited, and dead animals must be buried within 24 hours. One cardinal rule where the property owner objects is that a case should never be taken into court unless the state can win. In order to be of assistance to property owners, inspectors carry a book on types of small sewage treatment plants and a table on soil seepage.

Mr. Almquist also dwelled on the subject of housing developments, saying that there are three means of attacking this problem. Where there are a large number of houses, districts must be set up for sewage disposal. In small developments, local ordinances may be available with provision that

Head Table and Some of the Ladies

(1)—Mrs. Roger Esty, Chairman of the Ladies' Entertainment Committee, and Mrs. Chas. Crump of Franklin, Mass. (2)—A dim shot down the Head Table at the Banquet. (3)—One of the prettiest Head Tables ever seen. (4)—Mrs. Leland G. Carleton of Springfield, Mass.; Mrs. Linn H. Enslow, wife of A.W.W.A.'s president; Mrs. Arthur C. King, wife of N.E.W.W.A.'s new president. (5)—Mrs. J. W. Riley, of Ware, Mass. and Mrs. Tom. Kennedy of Fitchburg, Mass. (Our apologies for not getting more of the attending ladies.)

building permits be withheld subject to the approval of plans for sewage disposal by the health department. In some instances it is possible to rely on zoning ordinances requiring that the lot be of sufficient size to permit the inclusion of a sewage disposal system. These zoning rules also prevent dumping lots and pig feeding. Trailer camps can be established only by local ordinance which requires the approval of the state department of health.

Mr. Almquist said that sanitarians are the first line of defense against water borne disease and to insure good operation of this defense, there must be adequate laws as well as good inspectors. Above all, it must be remembered that the safety of the supply is of vital importance.

WM. LARKIN, Regional Engr., N.Y. State Dept. of Health, New York City, asked if the representative of a water utility could enter the premises without an order. The answer was yes.

In reply to a question about the discharge of filter plant wash water sludges which might pollute downstream supplies, Mr. Almquist said that his department would not approve plans now for a water plant unless the sludge was lagooned or the liquor otherwise decanted before discharge into the stream. Downstream owners can sue for damages from such discharges.

LINN H. ENSLOW, Editor, *Water & Sewage Works*, asked where the 250 ft. limit came from. Mr. Almquist did not know, but said that where the distance is greater than 250 ft., the problem had to be worked out by good will between the department and the owner.

Diesel Engines

"MODERN DIESEL PRACTICE FOR WATER WORKS PLANTS" was the title of the paper presented by David Gallagher, Engineer, Public Works Division, Worthington Pump and Machinery Corp., Harrison, N.J.

Mr. Gallagher said that the Diesel had come into use in the last 25 years, in New England, mostly for standby power generation and for driving pumps. Besides the ease of starting, these Diesel motors have ease of control of operation by varying the fuel load. As an example of the use of Diesels in water works, Mr. Gallagher cited the example of Fall River, Mass., and described the installation at that plant. After considering the several alternatives as to standby power (including electrical, steam, gasoline, and other sources), it was decided to use slow speed Diesel units because of low original cost, good standby characteristics, and low cost of continuous operation. Mr. Gallagher also showed slides of several other Diesel driven pump installations in New England and elsewhere.

During the discussion of this paper, TED H. KAIN, Gen. Mgr. of the Columbia Water Co., Columbia, Pa., said that in 15 years of operation of Diesel driven pumps in his plant, the total saving in power costs had amounted to $27,000. This fact was given full consideration in replacing the units with new Diesel engines. Mr. Kain pointed out however, that the differential between electric and Diesel power was no longer so great. Oil which formerly cost 4 cents a gallon in Columbia is now 11 cents a gallon. Other factors of maintenance and labor enter into the picture and a similar saving to that mentioned above is no longer possible. If oil continues to rise in price no saving at all may be expected.

DON C. CALDERWOOD, Supt., Pennachuck Water Co., Nashua, N.H., said his experience paralleled that of Mr. Kain and that the establishment of a favorable power rate made it cheaper to install electric power than to use Diesels. It was admitted that this favorable power rate was in some degree affected by the competitive aspects of the Diesel power.

A. M. BOEHM, also of the Worthington Pump and Machinery Corp., said that the field of application of Diesel engines undoubtedly was being affected by the price of oil but that the demand for Diesels still outstripped the production. Where supercharged units are used, power can be produced for about one cent per kwh. if the fuel oil cost is 14 cents per gallon. At 11 cents per gallon, the cost of power is approximately ¾ cent per kwh. To obtain comparative figures on operation costs, this figure can be used as a basis to compare with electric power.

Among other points brought out in the discussion was that some Diesels could be made to operate on a crude oil which cost about 4 cents less on a gallon, and that the availability of the fuel to a locality is an important item.

PAUL F. HOWARD, Cons. Engr., Boston, said that in one city the council had asked that the water department use Diesel engines in order that the city might have the power available for other demands. In this particular installation, the exhaust heat is used to heat the buildings at an annual saving in heating costs of 20 to 25 per cent. Mr. Boehm remarked that Midland, Mich. had gone one step further and not only recovered the heat but also used the carbon dioxide in the exhaust for recarbonation of lime-softened water.

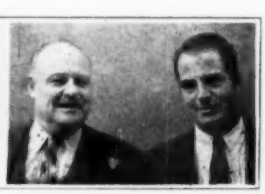
In answer to a question by HORACE CLARK, of Stanford, Me., Mr. Boehm said that operating speeds for con-

Programmers

John H. Murdoch
Counsel
W. Wks. Service Co.
New York

*F. A. O. Almquist**
Sr. Engineer
State Health Dept.
Hartford, Conn.

*(*Newly elected Director of NEWWA.)*



Jack Boyle
Edw. F. Hughes Co.
Boston

and

Thos. S. Lawrence
Supt. of Water
Groton, Mass.

Richard H. Ellis
Engineer
Asso. Factory Mutual Cos.
Boston

and

Scott Keith
Metcalf & Eddy, Engrs.
Boston

Edw. L. Jette
Mystic Valley Water Co.
Mystic, Conn.

Allan M. Symonds, Mgr.
Water Util. Serv. Co.
Millbury, Mass.

Ralph White
Contractor
Auburn, Mass.

Ernest L. H. Meyer
Sup't.
Water Dep't.
Glens Falls, N.Y.

and

Ray Sweeney
New England Mgr.
U.S. Pipe & Fdy. Co.
Boston

Sam'l. F. Newkirk, Jr.
Sup't. & Engr.
Water Board
Elizabeth, N.J.

and

Wm. Harmor
Engineer
Ozone-Wellsbach Corp.
Philadelphia

tinuous operation should be kept at speeds under 1200 ft. per minute for velocity of piston travel.

Siphon River Crossing

Stanley M. Dore, Deputy Chief Engr., Construction Div., Mass. Metropolitan Dist. Comm., presented an illustrated talk on "AN INVERTED SIPHON FOR THE ASSABET RIVER CROSSING OF THE WACHUSETTS AQUEDUCT." This aqueduct was first put into service fifty years ago. It is 12 miles long, two of which are in rock tunnel, three in open channel, and seven in a grade line aqueduct. Where this aqueduct crosses the Assabet river it emerges from the ground and is carried on a masonry viaduct. Between fifteen and twenty years ago, this section began to leak and in 1939 a gunite lining was installed to stop the leakage.

Within recent years the aqueduct began to leak again and considering the vulnerability of the exposed section as well as its condition it was decided to replace it with an inverted siphon. The siphon is 480 feet long and consists of steel plate ½ inch thick, 10 ft. 7-in. in diameter and lined with gunite mortar reinforced with wire mesh. The whole pipe is encased in concrete.

Mr. Dore described the construction of the project and the various problems encountered. Before the siphon could be put into service it was necessary to build two bypasses around the cut-ins. The actual cutting in of the siphon required but a month and the water had to be shut off only three days before cutting in started.

During the shut-down of the aqueduct an examination was made. It revealed that the interior surface of the aqueduct after 50 years was covered with about an eighth inch of slippery decayed vegetable accumulation like heavy wet soot or mucky peat deposit. Under this coating there was only slight decomposition. The surface of the mortar joints between the joints and the concrete, although somewhat soft and discolored to a depth of ⅛ in., was in good condition.

The total loss of head through the new siphon was found to be but 0.2 ft. more in the total distance of 400 ft. than was the loss of head through the original viaduct section.

Cape Cod Geology

Paul F. Howard, Whitman and Howard, Cons. Engrs., Boston, gave an illustrated paper on the "GEOLOGICAL ASPECTS OF THE MUNICIPAL GROUND WATER SUPPLIES OF CAPE COD." From the slides shown and the commentary delivered it was apparent that the forming of Cape Cod by at least three glaciers leaving their terminal moraines has had a decided effect on the existence of ground water supplies in the area.

In general the water has low hardness, but in some instances as the ground water table has been lowered there has been some salt water intrusion. In one place it is found that the water level in the wells rises and falls about a foot with the tides. There is no intrusion of salt water here, however.

Studies of the drillings, and geogical theories as to the formation of Cape Cod indicated that there are some buried ancient river beds, which may have been caused by the melting of one glacier and filled by the moraine of another. At any rate, it is possible to make rather safe predictions as to where water can be found, if one takes into consideration these geologic formations.

In all of the instances cited, Mr. Howard stated that they had installed gravel packed wells, 4 ft. in diameter, and that the wells run from depths of 27 to 70 feet. All waters are taken from above clay formations.

Seismic Reconnaissance

By the use of "SEISMIC RECONNAISSANCE FOR GROUND WATER DEVELOPMENT" it is possible to save both time and money in the search for water according to Scott Keith, Project Engr., Metcalf and Eddy, Cons. Engrs., Boston, Mass., and Rev. Daniel J. Linehan, S.J., Seismological Observatory, Weston College, Weston, Mass.

This is scientific "water witching or dowsing" by a method of approach commonly called "Doodlebugging" in the oil fields, where seismic reconnaissance is the tool for locating oil bearing shales and sands. In the oil fields the method makes use of reflective vibrations, but in shallow depths to which this method is applied for water supplies, Father Linehan has worked out a "refraction method."

By means of diagrams and pictures, Fr. Linehan showed how the method worked and the equipment used to obtain data on the depths of bed-rock and of various sands. While the method does not locate water it does locate the rock formations and the sand bearing strata which potentially locates water bearing strata.

In some instances the depth to rock was found actually to be as much as four to five feet more than indicated by the seismic determination. In others, the difference between estimated and actual depth was less than a foot. For six different locations varying in depth from 50 to 84 ft., it was found that the average difference between actual and estimated depth to rock was 3 feet. The real advantage of this method, which is so sensitive that passing trucks, aeroplanes, or farm tractors affect it, is in its speed and the economic saving by indicating where test wells should be put down. It has some limitations in locating exact layers of sand and gravel, but THOS. E. WIGGAN, Cons. Engr., New York, said that the seismic reconnaissance method had proved invaluable in the locating of bed rock for three dam-sites in the Rochester area where no information was available on the geologic structures.

E. B. Jones
Commissioner

Benjamin E. Fox
Commissioner

T. M. Beach, Supt.
Water Dep't.
West Springfield, Mass.

James W. Riley
Supt. of Water
Ware, Mass.

John B. Kennedy
Business Mg'r.
Water Dep't.
Winthrop, Mass.

Thos. E. Kennedy
Supt. of Water
Fitchburg, Mass.

John J. Fenolia
Worthington Pump & Machy. Corp.
Chicago

O. B. Carlisle
Chief Eng'r. of Water Wks. Design
Worthington Pump & Machy. Corp.

S. W. Kitson
Mgr. Public Works Div.
Worthington Pump & Machy. Corp.
Harrison, N.J.

Programmers

Roger W. Esty
Supt. W. & S.
Danvers, Mass.

Paul F. Howard
Whitman & Howard
Engrs.
Boston

Scott Keith
Project Engr.
Metcalf & Eddy
Engrs.

V. J. Calise
Technical Director
Liquid Condition'g Co.

Chlorinating Slow Sand Filters

Dr. Samuel Jacobsen, Chemist and Bacteriologist, and Marshall Wellington, Sanitary Engineer, both of the New Haven Water Co., New Haven, Conn., described the "INTRODUCTION OF PRECHLORINATION OF SLOW SAND FILTERS."

Dr. Jacobsen said that since the filters were installed in 1905, the top sands have been washed many times in an Allen Hazen sand washer but the bottom sands have never been washed. Sand scraping has been employed, but lack of labor and undesirable frequency had made it necessary to consider other means.

Prechlorination was the method resorted to in order to increase the efficiency of the filters and reduce the time between cleanings. After cleaning one filter, chlorine was added with the water, 1.4 ppm. being used, and it was found that the loss of head which normally occurred in 50 days did not occur until after 86 days of operation. It was also found that the filter to which chlorine was added passed a total of 153 mil. gal. compared to 86 mil. gal. for a filter not chlorine treated. The filter subjected to prechlorination could be back washed after raking the upper one inch of sand, but this treatment could not be used on the filters not receiving chlorinated water.

As another experiment, the addition of chlorine on top of the filter was made in the case of a bed that had not been cleaned. About 1.5 lb. of chlorine was used per cu. ft. of sand bed (15 ppm.). It took nearly 49 days to "cure" this bed. Immediately after the addition of chlorine, the color, odor, and turbidity of the effluent went up, making the water unusable for five weeks. After the treatment it was possible to obtain a 420 mil. gal. per acre rate or a 100 per cent increase, and the total output was increased by 72 per cent.

CHAS. R. COX, Prin. San. Engr., N.Y. State Dept. of Health, commented that these experiments had indicated that contrary to popular belief of long standing, the biological slimes in a slow sand filter could be ignored and the operation could depend on filtration effects alone. Dr. Jacobsen said that in the chlorinated filter the only biological life in the sands consisted of a few threadworms, compared to the myriads of forms and species in unchlorinated filters.

Clarification Problem Solved

A paper written by L. G. Smith, Supt. Kennebunk Water Co., Kennebunk, Me., and M. Lane, Tech. Dept., Liquid Conditioning Corp., Linden, N.J., was presented by V. J. Calise, Tech. Director, Liquid Conditioning Corp. The title of the paper was "SOLVING A DIFFICULT CLARIFICATION PROBLEM AT KENNEBUNK, ME." and it dealt with the problem of removing a high colloidal turbidity that appeared especially resistant to ordinary clarification procedures.

This turbidity appeared only following rains on the water shed and resulted from the exposure of clays during the construction of a new bridge across the river, serving as the surface water supply. The water resisted alum coagulation over a wide pH range, but it was found that the use of activated silica produced large tough flocs when the alum dose was reduced and a small amount of soda ash used to activate the silica.

Mr. Calise described the design of the plant and the equipment used for proportioning all feeds of chemicals to the flow of water. Because the activated silica forms a somewhat sticky floc, Anthrafilt is used as a topping for the filters because it is easier to wash. With this treatment, the water produced is quite acceptable.

Ion Exchange

At the end of one session, a representative of the Ion Exchange Dept. of the American Cyanamid Co., New York City, presented a sound movie in color, titled "Water, Water Everywhere". This motion picture shows the workings, both theoretical and actual, of ion exchangers and was quite informative.

Modern Equipment

One of the most interesting and instructive papers of this meeting was the presentation by Roger W. Esty, Supt., Danvers Water and Sewer Board, Danvers, Mass. Mr. Esty's paper was titled "MODERN EQUIPMENT IN WATER WORKS", and referred almost entirely to equipment for handling earth, and doing other jobs of construction and maintenance.

Perhaps one of the reasons why Danvers has increased its equipment of this type by more than $35,000 worth in the last 12 years is the energy of its superintendent in promoting economical improvements. This became obvious when Mr. Esty said that he had been able to show the townspeople that not only did the money for construction work stay in town but also that it was 40 per cent cheaper for the city to handle all of its own work.

As a result of this attitude, the Water Dept. of Danvers has obtained and now operates trucks of several kinds, air compressors, hand derricks, a Parsons trenching machine, a tractor, a bull-dozer, a 20-ton trailer, a Hobart welder, contractors' pumps, cement mixers, portable Alemite greasers, a Jenny Steam cleaner, and "The Machine of 101 Uses," the Hough Payloader.

Mr. Esty told how all of these various pieces of equipment were

C. B. French
Civil Engr.
Water Div.
Waltham, Mass.

F. L. Hatch
Supt.
Kittery Water Dist.
Kittery, Me.

Percy A. Shaw
Supt. Water Dept.
Manchester, N.H.

Thos. Lawrence
Supt.
Groton Water Co.
Grotow, Mass.

Richd. H. Ellis
Hydr. Engr.
Factory Mutual Ins.
Boston

used. (The Water Department rents its equipment to the Sewer Dept. for $15,000 a year.) Each piece of equipment has its own place and its own particular use but none of them are used so seldom as to be considered an expensive gadget. For example, there are some instances where the back hoe is best for trenching and in others the trenching machine is best. Likewise the Diesel powered bull-dozer is wonderful to clear land but for backfilling the angle dozer is more desirable.

With the trenching machine it has been possible to dig 900 feet of trench in 6½ hours, and as soon as the trench is dug the pipe can be laid. All sewer pipe laid in Danvers is placed on a bed of gravel and covered with gravel before backfilling.

Most popular machine not only with Mr. Esty, but also with his entire staff is the Hough Payloader, the machine with 101 uses. The complete story on this machine was told by Mr. Esty in the September number of *Water & Sewage Works*, and need not be recounted here.

The discussion of Mr. Esty's paper brought out that most of this mechanized equipment could be purchased on a rental plan.

Entertainment

In addition to the annual banquet which was preceded by a Cocktail Hour with the Water & Sewage Works Manufacturers' Assn. acting as hosts, there were other items of entertainment. On one evening a presidents' reception and dancing were available. For the ladies there was a sightseeing bus trip and a broadcast party, and Wednesday afternoon was given over entirely to a three-hour boat trip around Manhattan Island.

W. C. Mabee of Indianapolis Dies

William C. Mabee, who retired as Chief Engineer of the Indianapolis Water Co. in 1944, died late in August after an illness of several months. Mr. Mabee who was 74 years of age had retired after 42 years of service with the company. He was still a member of the Board of Directors.

"Bill" Mabee was active in the American Water Works Association affairs. In 1938 he received the Diven Memorial Medal for his work on water main specifications, and that same year received the Fuller Award from the Indiana Section. He was Chairman of the Indiana Section of A.W.W.A. in 1934.

Mr. Mabee joined the Indianapolis Water Co. as a constructing engineer in 1902, when he was in charge of development of filtration facilities. In 1917 he became Assistant Chief Engineer and in 1928 Chief Engineer of the company.

During his 42 years with the company in Indianapolis, Mr. Mabee saw the growth of the city from 185,000 to nearly 450,000. The public water supply in 1902 consisted of approximately 227 miles of water mains and about 1400 services, with a pumping capacity of 50 mgd. Today the pumping capacity is 250 mgd. with more than 800 miles of water mains and 95,500 water services.

RESEARCH GRANTS AWARDED BY U.S. PUBLIC HEALTH SERVICE

In Supplement No. 205 to the Public Health Reports (Jan. 1948), C. J. Van Slyke, Chief, Research Division of Grants and Fellowships, U.S.P.H.S., has presented the history of these grants.

In addition to listing all of the individual grants Mr. Van Slyke writes as follows:

"In line with the Nation's peacetime program of support for scientific research in medical and related fields, Public Health Service awards totaling $10,214,174 have been made during the last 20 months. Six hundred and twenty-nine scientists in 193 institutions are sharing in these grants.

"This Federal program, which was initiated in late 1945, is planned and directed by 250 of the country's foremost civilian scientists for the purpose of producing the research which they consider most essential to the improvement of the national health.

"The awards were made between January 1, 1946, and August 31, 1947. They support research projects in 97 universities and colleges and in 34 hospitals and clinics. An additional 62 research grants were made to foundations, sanatoriums, health departments, and individuals.

"Recipients of awards are given complete freedom to conduct projects in whatever way they choose. They are required to make only such reports as will assure the Government that the money being spent for their research is wisely and carefully used. Papers resulting from this work may be published at the authors' election and are not subject to review."

Of particular interest to readers of *Water & Sewage Works* are the 25 grants for 26 projects in the field of sanitation which are listed in the accompanying table.

SANITATION

Investigator and Institution	Subject Matter	Amount
Reid, G. W.—Georgia School of Technology	Water and sewage analysis	$ 15,950
Renn, C. E.—Johns Hopkins University	Microorganisms in drinking water	3,372
Silvey, J. K. G.—Northern Texas State College	Control of algae	3,145
Ehlers, V. M.—Individual, Texas	Research in sanitation	13,700
Bloodgood, D. E.—Purdue University	Cyanide and other toxic wastes	4,684
Cort, W. W.—Johns Hopkins University	Factors limiting rat population	14,320
Connell, C. H.—University of Texas	Chlorination of sewage	6,737
Nau, C. A.—University of Texas	Toxicology of arsine gas	5,430
Woolrich, W. R.—University of Texas	Factors affecting food preservation	3,947
Laffer, N. C.—University of Maryland	Examination of public water supplies	892
Rudolfs, W.—Rutgers University, New Jersey Agricultural Experiment Station.	Anaerobic digestion of sewage and industrial wastes	5,416
Rudolfs, W.—Rutgers University, New Jersey Agricultural Experiment Station.	Survival of tubercle bacilli in water	2,799
Rudolfs, W.—Rutgers University, New Jersey Agricultural Experiment Station.	Oxidation of soluble organic wastes	5,382
Boyce, E.—University of Michigan	Efficiencies of small septic tanks	10,832
Ashe, W. F.—University of Cincinnati	Nature of atmospheric contaminants	7,582
Rodebush, W. H.—Illinois State Water Survey	Detection of chemical contaminants in water	19,966
Gotaas, H. B.—University of California	Respiratory contamination test for swimming pools	1,700
Langelier, W. F.—University of California	Pollutional strength of sewages	892
Hatfield, W. D.—Federal Sewage Works of Illinois.	Analysis of sewage and industrial wastes	33,830
Sawyer, C. N.—Massachusetts Institute of Technology.	Biological stabilization of industrial wastes	10,413
Kilcawley, E. J.—Rensselaer Polytechnic Institute.	Capacity of soils for sewage disposal	12,714
Mallmann, W. L.—Michigan State College	Sewage effluents and truck-crop soils	3,570
Hartsell, S. E.—Purdue University	Pathogenic bacteria in frozen foods	4,429
Olson, T. A.—University of Minnesota	Plankton toxins in water supplies	8,225
West, P. W.—Louisiana State University	Determination of copper in water	2,695
Total		$202,545

POLLUTION LOAD CAPACITY OF STREAMS

by
HAROLD ALLEN THOMAS, JR.
Assoc. Prof. San. Engr.
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MODERN concepts of the self-purification of streams stem from the thorough investigations started in 1913 by the United States Public Health Service.[1] Without doubt the most significant fact established in these investigations was the value of dissolved oxygen concentration as a primary measure of the pollution load capacity of a stream. In a quantitative way it was shown that the oxygen balance not only *indicates*, but *controls* the state of self-purification. The mechanism of the oxygen balance was described with mathematical exactness in the "oxygen sag" concept.

Intervening years have demonstrated the validity of the principles that were set forth. Unfortunately, however, the mathematical aspects of the analysis have for the most part proved less helpful to the stream analyst than was originally expected. The drawback has been the difficulty in estimating the various constants in the formulation that express the effect of turbulence and degree of biochemical activity in the stream. Despite this qualification, however, a large number of investigators have found the formulation quite useful in predicting the reactions of streams to changes in the pollution load.

Certainly, there is no more central problem of sewage treatment and disposal than that of evaluating the capacity of streams to receive pollution loads. Only by such evaluation is it possible to apportion equitably among the users of a stream its natural capacity to handle and to purify domestic and industrial wastes.

With ever-increasing interest in the country regarding the condition of inland waterways, it is pertinent to examine critically the formulation of the oxygen balance in order to ascertain how it can be made more generally useful. While developments in the past two decades have not changed the basic ideas of the mechanism of the oxygen balance, they have indicated the desirability of some extension of the concepts. The improvement of the B.O.D. test, for example, has thrown new light on the significance of the constants in the oxygen balance formulation. Moreover, an increase in the facilities for sampling and testing of streams has made it desirable to introduce new and more precise methods of analyzing stream data.

Dynamics of the Oxygen Balance

In any reach of a stream that is fairly uniform as to cross-section and turbulence, the transfer and utilization of oxygen may be conceived to occur as indicated schematically in Fig. 1. In the zone of degradation in a stream downstream from a sewer outfall, oxygen coming from the atmosphere (III) is insufficient to supply the oxygen requirements of the micro-organisms, and therefore the dissolved oxygen concentration in the water will be diminished (I > II). The B.O.D. is generally reduced in passing through a reach, by biochemical oxidation and sedimentation (VI, VII). At times, however, it may be increased in passage (V>IV), by channel scouring or anaerobic flotation of the bottom deposits. In the long run, however, in a stream receiving a fairly constant pollution load the average weight of incoming B.O.D. must exceed that of the outgoing B.O.D. (IV > V)—that is, the time-average of the transfer to and from the bottom (VII) is zero.

Laboratory and field tests have indicated that the following relations hold approximately:—

(**a**) The rate of deoxygenation is proportional to the B.O.D. remaining.

Rate of deoxygenation $= 2.3\ k_1 L$ Eq. (1)

where L = the ultimate B.O.D., in ppm. of the polluted water at the point under consideration

and k_1 = the constant of proportionality reflecting the availability of the organic matter and the number and activity of the organisms present.

The constant 2.3 is added in this and the following rate equations to simplify the final working equation. It should be noted that it is the *ultimate* B.O.D. rather than the *five-day* B.O.D. that is involved in equation (1). The ultimate B.O.D. should be determined experimentally by long-term tests.

(**b**) The rate of re-aeration is proportional to the oxygen deficit in the stream.

Rate of re-aeration $= 2.3\ k_2 D$ Eq. (2)

where D = the oxygen deficit, in ppm. of the stream at the point under consideration
= the saturation concentration, in ppm., of D.O. at the temperature of the stream *minus* the actual D.O. concentration, ppm.

and k_2 = the constant of proportionality reflecting the degree of turbulence and the transfer-efficiency of the air-water interface film. For a fixed degree of turbulence, this constant is approximately inversely proportional to depth. Turbulence in turn depends upon stream velocity, depth, and roughness of the channel bed.

(**c**) The rate of deposition is proportional to the B.O.D. remaining.

Rate of removal of B. O. D. due to deposition $= 2.3\ k_3 L$ Eq. (3)

where k_3 = the constant of proportionality reflecting the composition of the waste and receiving water and the quiescence of the stream at the point under consideration. In regions of considerable turbulence, k_3 at times may be negative, indicating channel scour, which reverses the effect of deposition.

All three constants are affected by temperature, and all three have the same units (per day). It should be emphasized that while the foregoing relations are only approximate, they are in reasonable agreement with actuality and provide a rational framework to the analysis of stream data.

The constant k_3, while primarily a property of the waste, is to a considerable extent determined by the activity of the microbic growth in the stream. Another factor that affects the magnitude of k_3 is the degree of longitudinal hydraulic mixing that takes place in the stream. The greater the mixing, the smaller will be the value of k_3 as calculated from B.O.D.

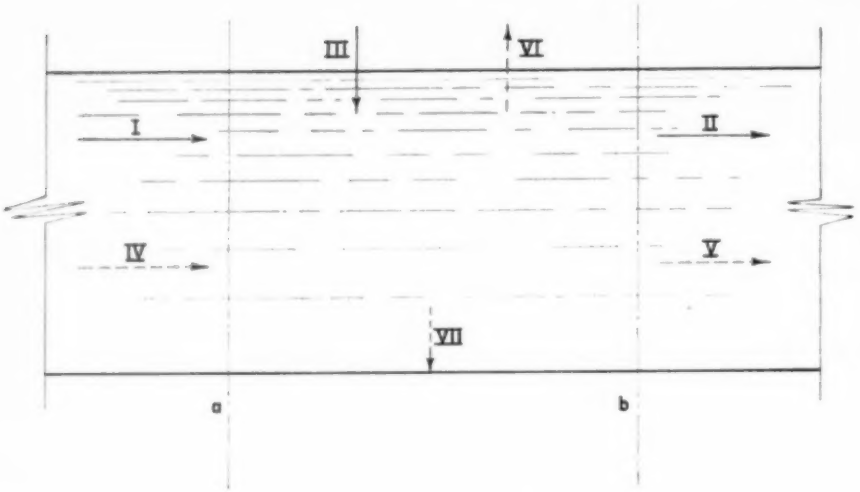


Fig. 1. Oxygen Balance Relations.

The numerals represent transfers in a reach as follows: I and II—D.O. entering and leaving in flow; III—oxygen entering from the atmosphere; IV and V—B.O.D. entering and leaving in flow; VI—gases such as carbon dioxide and methane leaving water; VII—B.O.D. entering bottom deposits.

measurements made at two adjacent sampling points. On the other hand, the effect of deposition of organic solids in the reach is to increase the value of k_1 as calculated from B.O.D. measurements made at two adjacent sampling points. As will be shown, however, k_1 should be calculated from laboratory studies of the rate of B.O.D.

Various methods have been proposed to account for the role of bottom deposits in the oxygen balance of streams. It is believed that equation (3) provides the most generally satisfactory representation of the influence of bottom deposits from the standpoint of both rationality and simplicity.

Incorporating the foregoing relations in a mathematical analysis of oxygen balance, the following equation may be derived:

$$D = \frac{k_1 L_a}{k_2 - k_1 - k_3}\left[10^{-(k_1 + k_3)t} - 10^{-k_2 t}\right] + D_a 10^{-k_2 t} \quad \text{Eq. (4)}$$

where, in addition to quantities previously defined,

D_a = the oxygen deficit, in ppm. at the upstream end of the reach.

L_a = the B.O.D. in ppm. at the upstream end of the reach.

and t = the average time of flow, days, to a point downstream in the reach where the deficit is D.

Equation (4) is the most general form of the oxygen-sag equation. For certain special cases it may be simplified. For example, when $k_1 = k_2$ and $k_3 = 0$ (no deposition), equation (4) may be written

$$\log D/L_a = \log k_1 t - k_1 t \quad \text{Eq. (5)}$$

Some insight into the character of the relations between the variables in the oxygen-sag equation may be had from examination of Fig. 2, which indicates the oxygenation rate (dD/dt) of a flowing unit-volume of water in a stream after the addition of sewage.

Measures of Pollution Load Capacity

The principal objective of the formulation embodied in equation (4) is to provide a basis for evaluating the capacity of streams to receive a pollution load. It is evident that the constants k_1, k_2 and k_3 are essential measures of pollution load capacity, and it is worthwhile to indicate their significance quantitatively. This is done by an example.

Example 1—A town discharges 1.0 mgd. of settled sewage of 100 ppm. ultimate first-stage B.O.D. and 0 ppm. D.O. into a stream with an average flow of 11 mgd., 4 ppm. of ultimate first-stage B.O.D., and 9.2 ppm. D.O. The temperature of both sewage and stream is 68°F. The combination of these two fluids results in a flow of 12 mgd. 12 ppm. B.O.D. and 8.43 ppm. D.O. Since at 68°F the saturation value of D.O. is 9.2 ppm., the initial oxygen deficit is $D_a = 9.2 - 8.43 = 0.77$ ppm. The resulting oxygen deficits, obtained by using equations (4) and (5) for various values of k_1, k_2, and k_3, are compiled in Table I.

The range of values of the stream pollution constants for most American streams handling non-toxic wastes during warm months, as calculated from data presented in recent stream surveys, would appear to be as follows:

k_1 per day:	0.06 to 0.36
k_2 per day:	0.06 to 0.96
k_3 per day:	−0.36 to 0.36

Since all three stream pollution capacity constants vary with temperature and turbulence of flow, they will undergo a cyclic annual change. Ordinarily, however, in a particular stream a more or less definite critical period will exist, such as induced by warm weather and low flow, or perhaps by wastes from seasonal industries. It is the magnitude of the stream constants during the critical period that delimits the pollution load capacity of the stream.

Effect of Sedimentation and Channel Scour

It is important to observe that while the time-average value of k_3 is zero, it may fluctuate suddenly with temperature changes and varying rates of flow and channel conditions. During the greater part of the time in a particular stream reach, k_3 may be positive, as in Case *iii*; then it may quickly become negative during a flood, or a period of stagnation in warm weather that causes fragments of the bottom deposits to be carried to the surface by gases of anaerobic decomposition. These possibilities are particularly important if they occur during the critical season. Case *iv* indicates the marked effect of a small negative value of k_3 upon the D.O.—namely, a substantial increase in magnitude of the maximum deficit.

Table I

Oxygen Deficits, (ppm.) with Various Values of Stream Pollution Capacity

Time, days	Case *i* $k_1 = 0.12$/day $k_2 = 0.12$/day $k_3 = 0.00$/day	Case *ii* $k_1 = 0.12$/day $k_2 = 0.24$/day $k_3 = 0.00$/day	Case *iii* $k_1 = 0.12$/day $k_2 = 0.12$/day $k_3 = 0.06$/day	Case *iv* $k_1 = 0.12$/day $k_2 = 0.12$/day $k_3 = -0.06$/day
0	0.8	0.8	0.8	0.8
½	2.1	1.9	2.0	2.1
1	3.2	2.6	2.8	3.2
2	4.2	3.2	3.6	4.7
3	4.7	3.1	3.7	5.5
4	4.6	2.7	3.4	5.9
5	4.4	2.3	3.0	6.0
6	4.0	1.9	2.6	5.9
8	3.0	1.2	1.8	5.3
10	2.1	0.7	1.1	4.5

The constant k_3 may also take into account the effect of irregular, non-continuous pollution, dilution, and other disturbing influences within the reach. If such irregularities occur, the time-average value of k_3 will not necessarily be zero. In some streams deposition, channel scour, and non-continuous pollution and dilution are not major factors and it is permissible to assume k_3 to be zero. This assumption has usually been made in previous applications of the oxygen balance formulation.

In applying equation (4) it is necessary to divide the stream into a series of substantially uniform reaches. At points of marked change in the channed cross-section or slope, or at points of significant additional pollution or dilution, new reaches should be introduced, each with its individual set of pollution load capacity constants. Precise estimates of the pollution load capacity of a stream may be formed only when the sampling stations are sufficient in number to divide the stream into fairly homogeneous reaches. The samples collected should be composited over a period of time long enough to be representative of the daily variation in flow and character of the water. This may entail 24-hour compositing at stations near sources of pollution.

Nomogram for the Oxygen Sag

Equation (4) is unwieldy and in most practical applications can be solved only by tedious trial-and-error procedures. This disadvantage may be overcome by the use of nomograms, one particularly useful type of which is presented in Fig. 3. In this figure, k_3 is taken as zero—that is, the effect of bottom deposits is considered negligible. The use of the nomogram is indicated by the following example.

Example 2—Assuming the data of Example 1, determine the oxygen deficits as given in Case *i*, in which $k_1 = 0.12$ per day, $k_2 = 0.12$ per day, $k_2/k_1 = 1.0$, $D_a = 0.77$ ppm., and $L_a = 12$ ppm. Using a straight-edge, form a straight line, called an *isopleth*, connecting point $0.77/12 = 0.064$ on the D_a/L_a scale at the left with, say, the point representing the first day, $k_2t = 0.12 \times 1 = 0.12$ at the intersection of the line 0.12 on the k_2t scale on the $k_2/k_1 = 1.0$ curve. This isopleth is indicated by a dashed line in Fig. 3.

Next, read 0.265 on the D/L_a scale at the intersection with the isopleth. Finally the value of the deficit at the end of the first day may be computed:

$$D = 0.265(12) = 3.2 \text{ ppm.}$$

In the same manner, deficits for other times may readily be evaluated. Of particular interest is the value of the maximum or critical deficit, D_c, which for the conditions of Case *i* may be determined by increasing the inclination of the isopleth until it becomes tangent to the $k_2/k_1 = 1$ curve. At this inclination the value of D/L_a reads 0.39, so that the critical deficit is $0.39(12) = 4.7$ ppm.

Using the nomogram in this manner, it is possible to compute oxygen deficits, including the critical deficit, corresponding to any set of conditions. A useful collection of tables and graphs has been developed by Fair[2] to facilitate computations pertaining to the critical deficit.

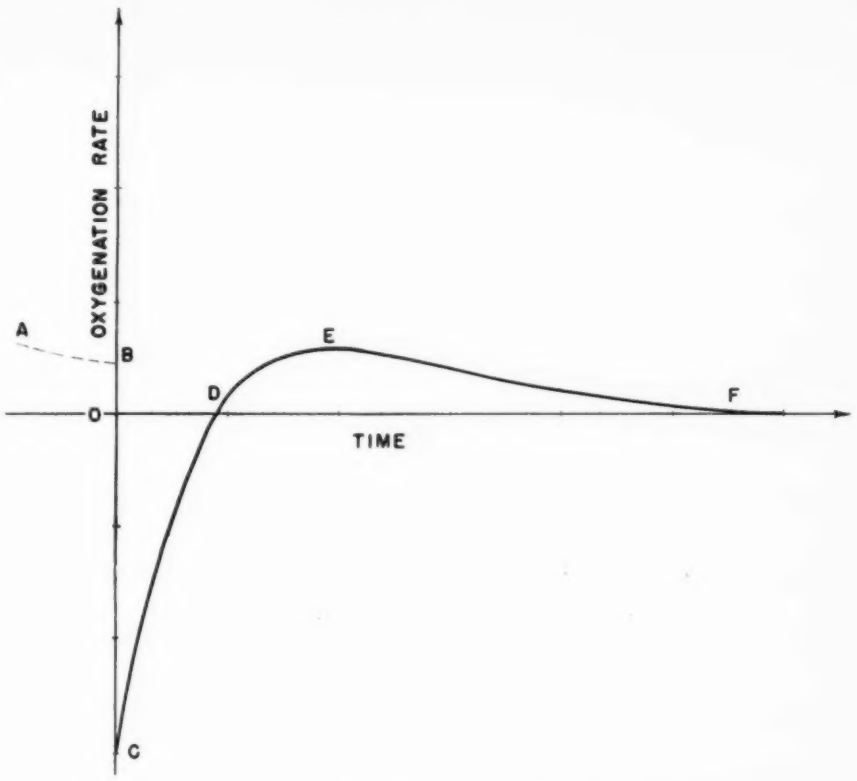


Fig. 2. Oxygenation Rate in a Stream below a Sewage Outfall.
The significance of the various portions of the curve is as follows: AB—positive rate from antecedent pollution; BC—sharp reduction to negative rate (deoxygenation) at outfall (zone of degradation); D—atmospheric reaeration just balances rate of biochemical oxygen demand with dissolved oxygen at a minimum (zone of active decomposition); E—maximum rate of oxygenation, dissolved oxygen increasing (zone of recovery); and F—oxygenation rate small, dissolved oxygen near saturation concentration (zone of cleaner water).

Maximum Permissible B.O.D. Load

An important problem to be solved in connection with stream sanitation—one that is solved with difficulty with equation (4)—is that of finding the maximum B.O.D. load, L_a, that may be introduced so that the oxygen concentration will remain above a specified value downstream. Assuming that no deposition occurs, this problem may be solved approximately with the following formula:

$$\log L_a = \log D_c + \left[1 + \frac{k_1}{k_2 - k_1}\left(1 - \frac{D_a}{D_c}\right)^{0.418}\right] \log k_2/k_1 \quad \text{Eq. (6)}$$

If for a particular stream reach the constants k_1 and k_2 are equal, then equation (6) assumes a modified form:

$$\log L_a = \log D_c + 0.434(1 - D_a/D_c)^{0.418} \quad \text{Eq. (7)}$$

Example 3—With the data of Case *i*—($k_1 = k_2 = 0.12$ per day; $D_a = 0.77$ ppm.)—find the largest value of pollution load, L_a, that will permit the dissolved oxygen of the stream to remain above 2.0 ppm.

The allowable deficit, D_c, is $9.2 - 2.0 = 7.2$ ppm. Substituting in equation (7),

$$\log L_a = \log 7.2 + 0.434(1 - 0.77/7.2)^{0.418} = 1.27$$

$L_a = 18.7$ ppm., the maximum permissible B.O.D. load.

Evaluation of Stream Capacity Constants

The method to be selected for the evaluation of the pollution load capacity constants (k_1, k_2 and k_3) of equation (4) depends upon the

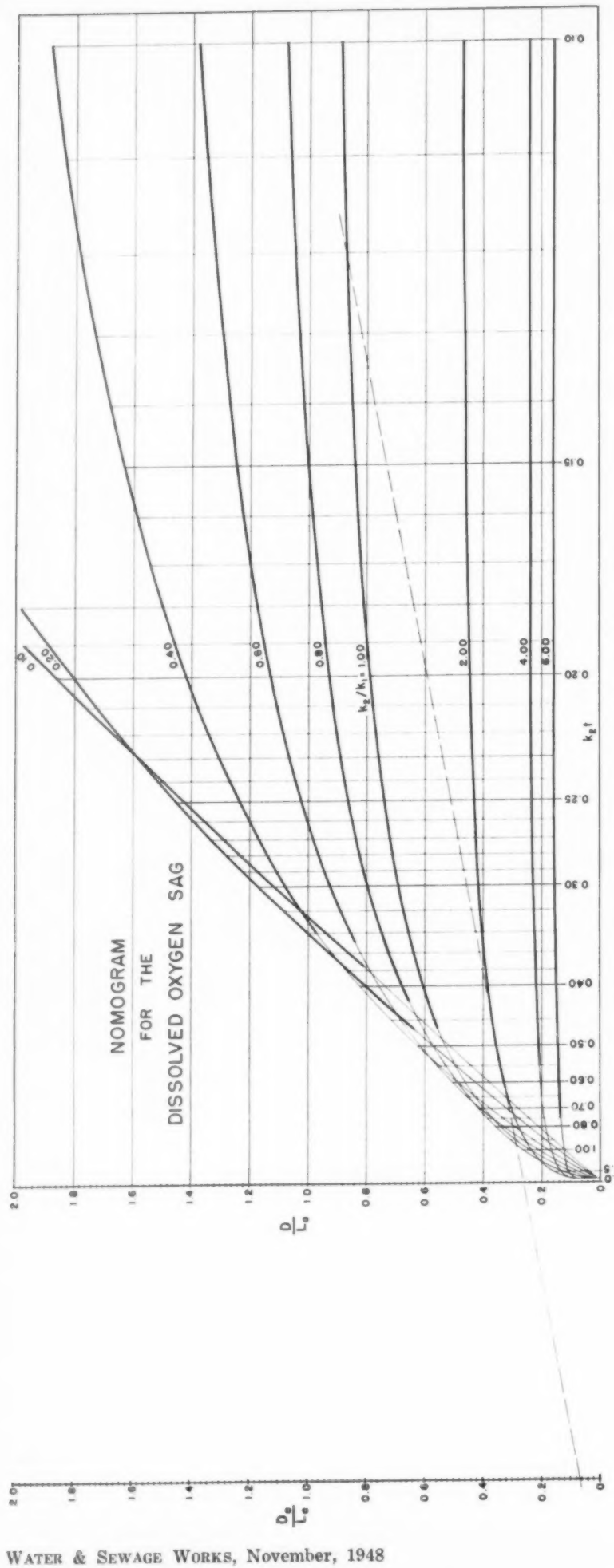


Fig. 3. Nomogram for the Dissolved Oxygen Sag.

Oxygen deficits downstream from a point of pollution may be determined from initial B.O.D. and D.O. and stream self-purification constants.

amount of stream data available. The procedure to be described is applicable to streams for which a fairly precise estimation of pollution load capacity is desired and for which sufficient data are available from sampling points at the end of well-defined reaches. The data consist of replicate values of B.O.D., D.O. and flow at each sampling point during the critical season. A significant reduction in the number of samples may be effected by collecting samples from the same pollutional "slug" as it passes downstream.

If the times of collection at successive stations are synchronized to sample the same mass of fluid as it flows by, the samples will constitute a homogeneous set that indicates the over-all condition of the stream. A few sets of this type provide more information of value than a large number of random, non-synchronized samples collected over a longer period of time. Values of the constants k_1, k_2, and k_3 for each reach of the stream should be computed for each homogeneous set of data.

If it is not feasible to collect synchronized samples, the constants may be evaluated from median values of B.O.D., D.O. and flow rate during the critical period, provided that the amount and composition of the organic pollution remains fairly uniform. In streams where disturbing influences such as deposition and channel scour occur during the critical season, a considerable amount of data, including observations during periods of high flow, may be required to establish the pollution load capacity with precision.

The values of k_1, k_2, and k_3 for each set of samples may be determined from the following formulas, which may be derived from equations (1) to (4):

$$k_1 + k_3 = \frac{1}{\Delta t} \log \frac{L_a}{L_b} \qquad \text{Eq. (8)}$$

$$k_2 = k_1 \frac{\overline{L}}{\overline{D}} - \frac{\Delta D}{2.3\ \Delta t \overline{D}} \qquad \text{Eq. (9)}$$

where L_a and L_b = the ultimate B.O.D., in ppm. or lb., at the upstream and downstream ends of the reach, respectively.

$\overline{L} = 0.5(L_a + L_b)$, the average ultimate B.O.D. in the reach, (ppm. or lb.)

$\overline{D} = 0.5(D_a + D_b)$, the average D.O. deficit in the reach, (ppm. or lb.)

$\Delta D = D_b - D_a$, the change in D.O. deficit in the reach, (ppm. or lb.)

and Δt = mean time of flow through reach, days

Equation (9) is derived on the assumption that the reach is sufficiently short so that the oxygen deficit profile within the reach does not differ from a straight line by more than a negligible amount. If this is not the case, then k_2 must be evaluated from equation (4) by a trial-and-error procedure. The values of k_1, L_a, and L_b are determined from laboratory B.O.D. incubation tests at 20°C. The oxygen demand exerted at different times—1, 2, 3, etc., days—is measured and the data are fitted by an equation of the type

$$y = L(1 - 10^{-k_1 t}) \qquad \text{Eq. (10)}$$

The k_1 values obtained in this way will usually decrease going downstream from a point of pollution; this indicates that the remaining unoxidized organic matter becomes increasingly less available to the micro-organisms. In any reach, however, the average k_1 value should be used in equation (9) in the determination of the re-aeration constant k_2. The k_1 and L values obtained in the laboratory should be corrected to stream temperature before being used in equation (9). Finally, for purposes of comparison, the calculated k_2 value may be reduced to its equivalent 20° value. The usual temperature correction factors which multiplied by the 20° values give the values of k_1, k_2, k_3, and L at stream temperature are shown in Table II above.

Table II

Temperature Factors for Oxygen-Balance Constants

Temp., °C:	16	18	20	22	24	26
For k_1	0.832	0.912	1.000	1.096	1.202	1.317
For k_2	0.939	0.969	1.000	1.032	1.065	1.099
For k_3	0.752	0.867	1.000	1.153	1.331	1.535
For L	0.920	0.960	1.000	1.040	1.080	1.120

As an example of the foregoing method of calculation of stream constants, the following data reported by Kittrell and Kochtitzky[3] for a shallow, turbulent stream are analyzed.

Example 4—A 4.6-mile reach of a stream, about seven miles below a city of 28,000 persons, had an average velocity of 0.65 fps., the flow time being 0.438 days. The flow increased from 484 to 504 mgd. in passage through the reach; the average temperature was 23.1°C. B.O.D. tests (20°C) and D.O. tests (23.1°C) gave the following results:

Station	k_1, per day	L, ppm.	D, ppm.
Upstream	0.20	6.00	6.27
Down stream	0.16	3.31	3.81

Converting to pounds of B.O.D. and D.O. deficit and adjusting to 23.1°C with appropriate factors from Table II, the following values are obtained:

Station	k_1, per day	L, lb.	D, lb.
Upstream	0.231	25,720*	25,310
Downstream	0.185	14,780	16,010
Average	0.21	20,250	20,660

*25,720 = 6.00 x 8.34 x 484 x 1.062

From equation (8)

$$k_1 + k_2 = \frac{1}{0.438} \log \frac{25{,}720}{14{,}780} = 0.55 \quad \text{and} \quad k_2 = 0.55 - 0.21 = \underline{0.34 \text{ per day}}$$

From equation (9)

$$k_2 = 0.21 \frac{20{,}250}{20{,}660} - \frac{16{,}010 - 25{,}310}{2.3(0.438)20{,}660} = \underline{0.65 \text{ per day}}$$

It is hoped that these simplified methods of determining the stream constants will facilitate the application of the oxygen balance analysis and will encourage a wider understanding of the factors that determine the pollution load capacity of streams.

References

(1) Streeter, H. W., and Phelps, E. B. A Study of the Pollution and Natural Purification of the Ohio River. *Public Health Bulletin* 146 (1925).

(2) Fair, G. M. The Dissolved Oxygen Sag—An Analysis. *Sewage Works Journal* XI, 445 (1939).

(3) Kittrell, F. W., and Kochtitzky, O. W. Jr. *Sewage Works Journal 19*, 1032 (1947).

Dr. and Mrs. J. V. N. Dorr Back from Triple European Mission

Visited Sewage Works and Collected Much Material for Film—"The Story of The Dorr Co."

Dr. J. V. N. Dorr, president of the Dorr Co., and Mrs. Dorr recently returned from Europe where they spent the summer, attending the annual meeting of the Society of Chemical Industry in Edinburgh, visiting the staffs of The Dorr Company's associates in England and the Continent and collecting material for a documentary colored motion picture film "The Story of The Dorr Company", which is being produced by Mrs. Dorr in collaboration with Erica Anderson, whose industrial films are well known.

Among the sanitary engineering installations visited was the new sewage disposal plant at Versailles, France, just starting up and carrying further the work last done there by Louis XV. The Achere Sewage Treatment Plant of Paris, one of the largest built during the war, was also seen. Mr. Dorr reports that some of the plants serving London were found to have withstood considerable bomb damage. The largest of these, the Colne Valley Works, was started before the war, but expansion west of London has become so great that actually before the initial plant is completed an addition will be under order. It is the first plant in England equipped to provide either drying and marketing of the digested sludge, or sludge incineration, as changes in the comparative economics of the two methods of final disposal of the organics may warrant.

In the course of the summer the Dorrs and others connected with the motion picture project traveled over 5000 miles by station wagon and covered ten different countries, from northern Sweden to southern Italy. They report that water and sewage works men everywhere, from consulting engineers to plant operators, evinced considerable interest in the film and enthusiastically entered into its production.

Our Mistake!

Longley–J. R.; Longley–J. E. and an Overworked Secretary

In our October number there appeared an article by J. R. Longley of Peoria, Ill., on the practice of "Cleaning Air Diffuser Plates by Sand-blasting." The picture, therewith, captioned "The Author," unfortunately was not the author's picture, but was that of another Longley—Longley, J. E. The mistake was made by an overworked secretary who failed to note the difference in the middle initial when pulling the cut proof from the file.

As a matter of interest, the two Longleys (no relation) do not look too much unlike and therefore we are not apologizing to either, but regret our mistake none the less.

The cut used was that of J. E. Longley, Secretary of the Lock Joint Pipe Co., Ampere, N. J.

PENNA. WATER WORKS OPERATORS HOLD 21st ANNUAL MEETING

Demonstration of Hydraulics Outstanding Feature

Inspection Trip, Huntingdon, Penna.

MEETING once again, on the campus of the Pennsylvania State College at State College, Pa., the Pennsylvania Water Works Operators' Association held its 21st Annual Conference. More than 250 men registered for the meeting and these, together with their wives, made a total attendance at the meeting of more than 300.

Presidents

Incoming
C. P. Abraham
Superintendent
Bur. of Water
Lancaster

Outgoing
T. G. Braman
Manager
Citizens Water Co.
Washington

As is customary, the conference opened on Monday, with a golf tournament and soft ball game, but all was not play at the meeting. Two evening sessions, two morning sessions, and an inspection trip were included on the program.

Business Session

At the annual business session, Secretary I. M. Glace, Cons. Engr. of Harrisburg, Pa., announced a net gain in membership of 27, the result of 44 new and 17 lost members, including 8 deaths.

The most important feature of the business session was the election of new officers. For the ensuing year, the following persons will conduct the affairs of the association:

President

Charles P. Abraham, Supt.
Bureau of Water, Lancaster, Pa.

1st Vice President

George W. Naylor, Mgr.
Punxsutawney Water Service Co.
Punxsutawney, Pa.

2nd Vice President

Rennie I. Dodd, Exec. Dir.
Chester Municipal Authority
Chester, Pa.

Secretary-Treasurer

I. M. Glace, Cons. Engr.
Harrisburg, Pa.

T. H. Kain, Mgr. Columbia Water Co., Columbia, Pa., Chairman of the Short Course Committee, announced that a short course for water works operators would be held at State College, under the direction of Prof. Robert E. Stiemke on October 25-29, inclusive.

Elements of Coagulation

As usual, the technical sessions were held in Room 111 of the Electrical Engineering Building. As usual, too, the meeting was welcomed by J. O. Keller, Assistant to the President of Pennsylvania State College. Mr. Keller recalled the organization of the association 21 years ago, and its growth in the interim.

The first session of this meeting, held on the evening of August 23, was presided over by President Tom Braman, Mgr., Citizens Water Co., Washington, Pa. Mr. Braman called attention to the fact that only in a country enjoying freedom such as is known in the United States, can such associations as that of the Water Works Operators exist and meet.

The technical portion of this evening session was devoted to the presentation of the elements of coagulation, with demonstrations ably presented by D. PAUL ROGERS, Principal Chemist and R. J. SCHATZ, Sanitary Engineer of the Pennsylvania Department of Health in Harrisburg. This feature was billed as "A Visualization of the Effect of Over-Dosing, Under-Dosing, Influence of Mixing Time, and Other Factors in the Coagulation of Water."

Mr. Rogers opened his talk with a discussion of the size of particles which are important in coagulation and flocculation of water. The particle sizes may vary from 1/2,000,000 to 1/250,000 of an inch. It is the removal of such suspended solids which helps prepare the water for filtration. Defining coagulation as "the reaction which changes soluble substances to insoluble precipitates and changes non-settleable solids to settleable solids," Mr. Rogers brought to his listeners the fundamentals of the subject. In addition to naming various coagulants which are used, and aids to coagulation, such as activated silica, Mr. Rogers said that the time for settling should be a minimum and that settling rates depend on the weight, size, and shape of the particle, as well as the friction created in the water. Flocculation is the process by which insoluble precipitates and suspended solids are agglomerated or coalesced into flocs.

Among the features which make for a good coagulant are non-toxic properties, relatively low cost, as well as its ability to react as a coagulant, and have a negative charge. An important factor in coagulation is the pH range.

Officers

1st V.P.
G. W. Naylor
Manager
Punxsutawney

Secy.
I. M. Glace
Cons. Engr.
Harrisburg

2nd V.P.
R. I. Dodd
Exec. Dir.
Chester

Programmers

Hydraulics

R. E. Stiemke
Professor
Penn State
State College

R. R. Kountz
Asst. Prof.
Penn State
State College

Operation
K. C. Armstrong
Superintendent
Muni. Auth.
Chester

Flow Tests
M. P. Casey
Engineer
Fire Underwriters
Philadelphia

Fluoridation
H. A. Faber
Res. Chem.
Chlorine Inst.
N.Y.C.

Chlorine
Ralph Carr
Engineer
Mathieson Corp.
N.Y.C.

While certain substances are precipitated by negative charge on the part of the coagulant, others, such as colloids and color are neutralized and precipitated by the trivalent aluminum ion.

For the determination of the optimum alum dose, the speakers recommended the use of jar tests. By means of jar tests performed before the audience, Messrs. Rogers and Schatz showed how to determine optimum dose and the pH at which the flocculation would be best. Also shown were the effects of over-dosing and the effects of mixing, plus settling, as against plain mixing for producing good flocculation.

Mr. Rogers concluded his talk with the following statements:

"1. Rapid mix is essential.

"2. pH determination is indispensable.

"3. Slow mix preceding sedimentation is the best for flocculation."

Chester, Pa. Plant Operation

K. C. Armstrong, Supt. of Filtration, Chester Municipal Authority, Chester, Pa., presented a paper on "THE OPERATION OF THE CHESTER FILTER PLANT." This was the first of a proposed series of practical papers on the operation of typical filter plants in Pennsylvania, to be presented by operators for operators. Next year it is proposed to discuss the Lancaster, Pa., Water Supply.

In introducing his topic, Mr. Armstrong stated that the water supply was taken from the Delaware River, containing a "tremendous amount of sewage and trade waste, which have resulted in giving it the reputation of being one of, if not the worst, raw water supply in the country."

Beginning with the two river intakes, one 42 in. and the other 30 in., which extend 400 and 500 ft. respectively, into the river, Mr. Armstrong described the various steps of operation. Originally, these intakes were above the river bed, but because of deposition of sediment, they now rest on the bottom. As a result, there is a considerable amount of debris brought in with the water. This must be removed by traveling screens. Low lift pumps operate under difficult conditions and suction heads will vary from 9 to 23 feet, depending on the tide. Following the low-lift pumps are spray type aerators, which, because of flat bottoms, collect solids and require too frequent cleaning. Following aeration, chlorine is added, sufficient to produce a combined residual of 1 ppm., in the clear well. Dry chemical feeders are used and rapid mix is obtained by a hydraulic jump. Two dry feeders are used for alum and the third adds Pike's Peak clay, which is used for the removal of oil pollution. Slow mix of varying effectiveness follows and is, in turn, followed by sedimentation. Activated carbon to the amount of approximately 15 lb. per mil. gal. is added to the effluent of the sedimentation basin.

Ten 1.25 mgd. filters are the conventional type, but contain gravel, sand, and a topping of 3 inches of Anthrafilt, which has a 7 mm. effective size. The latter is renewed about every thirty months, because of a loss which occurs during the washing of the filters. Palmer filter sweeps have proved decidedly effective in keeping the filters clean. (On this point, Mr. Armstrong remarked that when he first took over operation of the plant, he did not believe that the Anthrafilt was effective and, after its loss, operated the plant without Anthrafilt for some time. A decrease in the efficiency of the filter and the general difficulties which followed, led Mr. Armstrong to replace the Anthrafilt and become a convert to its use, which he says is effective "roughing filter.")

Elements of Coagulation

D. Paul Rogers
Prin. Chem.
Dept. of Health
Harrisburg

R. J. Schatz
San. Engr.
Dept. of Health
Harrisburg

At times, the water in the Delaware River is completely anaerobic and hydrogen sulphide is produced. Chlorine demands have reached 110 lb. per mil. gal. High salt concentrations result from high tides backing up the river. The chloride content has reached as high as 1500 ppm., a concentration which would cause 100 tons of salt per day to pass through the plant. Water softeners in the town suffer constant regeneration and the effluent is as hard as the influent.

It is because of this highly undesirable water supply that the City of Chester has voted to raise water rates by 50 per cent and to go 40 miles away to obtain a new water supply at a cost of $9,000,000. While the taste and odors might be handled and other difficulties taken care of, the presence of the large amount of salt cannot be handled. This is primarily the reason for the new supply.

In the discussion which followed, LINN ENSLOW, Editor of *Water & Sewage Works*, pointed out that this was a good example of how it was possible to sell a new water supply to a city on the basis of public happiness, rather than public health.

In closing his paper, Mr. Armstrong emphasized these points:

1. Filter capacity is largely determined by the condition of the filter inload.
2. It pays to be alert for changes which will improve operation.
3. It is important to have stand-by units.
4. The service obtained from equipment depends largely on how it is treated.
5. Proper maintenance pays off.

Fire Flow Tests

"ANALYSIS OF PIPE CONDITION BY MEASUREMENT OF CARRYING CAPACITY," was the title of the paper written by R. F. Goodhue, Chief Engineer, Middle Department Rating Associa-

Flow of Water in Pipes

Lecture-Demonstration In Popular Style on Fundamentals of Hydraulics

Prof. Kountz Weighs Water as Prof. Stiemke Describes Experiment

Lecture-Demonstration Team Left to Right—Don Keagy, Tom Iezzi, R. R. Kountz, R. E. Stiemke, and Ray Murphy

Prof. Stiemke Demonstrates Loss of Head

tion, Fire Underwriters, Philadelphia, Pa. In the absence of Mr. Goodhue, the paper was presented by M. P. CASEY, Engineer. This paper was prepared as an aid to operators of water systems, where analysis of distribution systems and supply mains is limited by either personnel or equipment. As a practical aid in making such analyses, the paper presented a discussion of the fire flow test. While these tests do not produce the accuracy of pitometer, or piezometer readings, their error is within 10 per cent. These flow tests were made to determine the quantity of water available from any point in the supply main, or distribution system, by establishing the hydraulic slope of the main at that point. The only equipment needed consists of two 3-inch gauges, one of 200 psi. capacity and one of 30 or 50 psi, plus two hydrant caps, drilled and tapped to receive the ¼ in. pipe thread of the gages, and a hydrant wrench.

From these readings, the flow and pressure at these points is determined, and from those data, it is possible to establish the hydraulic slope from which the ultimate availability of the grid iron is readily computed. Mr. Casey gave the several formulas which are used in computing the availability of quantities in the distribution grid, and several examples. He pointed out that a series of these tests, plotted on a plan of the distribution system, provides practical and useful pictures of the underground pipe structure. Abnormal conditions, in any section, stand out and make it possible to locate such items as partially, or entirely closed valves, sub-surface leaks, etc.

In addition to these abnormal conditions, fire flow tests often show that the carrying capacity of the supply distribution system has been greatly reduced by incrustation or deposition of iron or manganese, or bacterial growth, or anything that will reduce the carrying capacity of the line. For the most part, according to Mr. Casey, many of the mains now in use have decreased carrying capacities to the point where a "C" value of 100 is high, whereas the "C" value for a new main is generally taken to be 130.

Included in the paper are tables on the method of computing fire flow available, from flow tests and a table of discharge of circular orifices.

Inspection Trip

Approximately 75 persons made the inspection trip of the filter plant and water works of the Borough of Huntingdon, located approximately 25 miles south of State College.

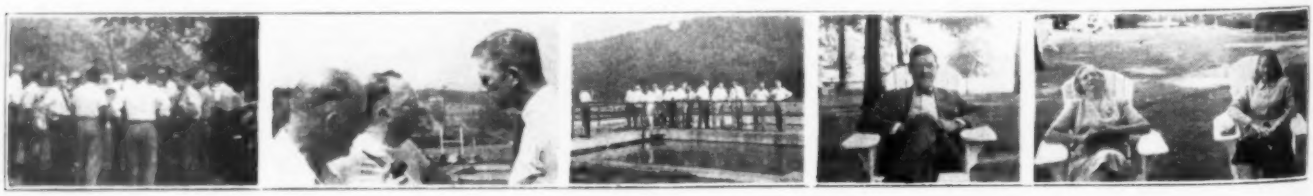
In the evening, a moving picture was shown, titled, "Water, Water, Everywhere." This is a movie released by the American Cyanimid Co. and shows the action of demineralization equipment.

Practical Hydraulics

The outstanding feature of the entire meeting was the lecture and demonstration in popular style, with the technicalities omitted, on the fundamentals of hydraulics. This presentation was titled "FLOW OF WATER THROUGH PIPES," and was presented by R. E. Stiemke and R. R. Kountz, respectively Professor and Assistant Professor of Sanitary Engineering, Civil Engineering Department, Pennsylvania State College.

Some of the demonstrations are shown in the accompanying photographs. The complete list of procedures and apparatus used to demonstrate liquid flow included the following:

1. Simple siphon discharging under different heads.
2. Automatic (intermittent) siphon.
3. Backsiphonage.
4. Flow in pipes
   a. Visual illustration of hydraulic grade line under static and flowing conditions using ¾-inch pipe and glass piezometer tubes of different shapes.
   b. Effect of diameter of pipe on the discharge, using ¾-inch and 1-inch new G. I. pipes at constant head.
   c. Effect of roughness of pipe on the discharge, using ¾-inch new G. I. pipe and ¾-inch old rusty pipe at the same head.
   d. Effect of head on the discharge, by varying the head on a ¾-inch pipe.
5. Losses in fittings
   a. Effect of 4 elbows in a ¾-inch pipe.
   b. Effect of 3 gate valves in a ¾-inch pipe.
   c. Effect of 3 globe valves in a ¾-inch pipe.
   d. Comparison of effect of 3 globe valves separated by pieces of pipe and three similar valves close together in the same pipe length.
   e. Effect of sudden enlargements and contractions—¾-inch to 2-inch.
   f. Effect of reaming the ends of pipes cut with pipe cutter using two coils of ½-inch



Here and There

Inspection Trip

Visit to Borough of Huntingdon

S. S. Cray, Boro Supervisor Fort Allegheny, Pa.
Marlin E. Wilt, Asst. Engr. State Dept. Health Williamsport
Karl Dahl, Asst. Engr. St. Dept. Hlth., Harrisburg

It Was a Warm Day in August

Off Hour Relaxation

A.W.W.A. Proxy Enslow

Mrs. R. W. Fitzgerald (Norfolk, Va.) and Mrs. Fred Stuart, Baltimore

V. F. Rigling
Ch. Engr.
Util. Serv. Corp.
Lemoyne, Pa.

J. M. Angell, Jr.
Eastern Mgr.
Wat. & Sew. Wks.
N.Y.C.

R. W. Fitzgerald
Supt.
Water Supply Div.
Norfolk, Va.

Fred Stuart
Pres.
Stuart Corp.
Baltimore, Md.

Seen Around The Sessions

E. A. Schmitt
Head Engr.
U. S. Engrs. Off.
Washington, D.C.

R. C. Beckett
State San. Engr.
Dover,
Delaware

and elbows, one with reamed, the other with unreamed ends.

6. Demonstration of change from velocity head to pressure head and vice versa, using ¾ to 3-inch pipes.

7. Demonstration of the use of orifice and venturi meters and a comparison of efficiencies using ¾-inch x ⅜-inch meters.

8. Orifices in a tank

a. Comparison of discharge rates from standard sharp-edged circular and standard short tube orifices of ⅝-inch diameter under the same head.

b. Inversion of the jet from a ¼-inch x 1-inch slotted sharp-edged orifice.

Assisting professors Stiemke and Kountz were Tom Iezzi, Junior Sanitary Engineer of the Pa. Department of Health, State College, Pa., Ray Murphy, Graduate Student in Sanitary Engineering at Pennsylvania State College, and Don Keagy, Under-Graduate in Sanitary Engineering.

(The following papers were reported by Harry A. Faber, Res. Chem., The Chlorine Institute, New York City, and Editorial Associate, *Water & Sewage Works.)*

Fluoridation

"Shall Fluoride be Added to Public Water Supplies?" This question was the title of a paper presented by Harry A. Faber, Research Chemist, The Chlorine Institute, Inc., New York. The author offered a summary of facts and opinions on this new treatment practice, evidently considering that the evidence would supply different answers under different circumstances.

In reviewing the subject of fluorides in water, Mr. Faber pointed out that natural water contains many known and many unknown constituents. While the condition of teeth termed mottled enamel has been recognized for fifty years, it was not until 1931 that the existence of fluorine in drinking water was discovered and it was identified as the causative agent of mottled enamel. Since that time it has been clearly established that there is no fluorosis (mottling) when the water contains 1.0 ppm. or less of fluoride. A U. S. population of about one million uses water so high in fluoride as to cause endemic fluorosis. Methods have been developed to remove or reduce the fluoride content of water, but they are so expensive and complicated as to be impractical.

By 1938, the reports of several investigators provided a large amount of evidence that when the public water supply contains about 1.0 ppm. of fluoride it maintains dental decay at a minimum, and does not produce mottled enamel. The fluoridation of a supply deficient in fluoride, to provide the desired 1.0 ppm. content of this element, can be easily accomplished by adding sodium fluoride. All evidence suggests that artificial fluoridation will produce the same beneficial effects as a water naturally containing fluorine, but the final answer must await the results of research studies now in progress.

The addition of fluoride under carefully controlled conditions is now regularly practiced by at least nine U. S. and Canadian public water supplies. It is generally supervised by the state health department and other agencies, in conjunction with regular dental surveys of children in the 5 to 14 year old group. This paper reviewed the causes of dental decay, and described the mechanism by which the fluoride ion is considered to act as an agent inhibiting decay.

Published opinions for and against the fluoridation of water were cited. It is clear that whether this treatment is termed fluoridation, or mass medication, or supplemental treatment, or even enrichment, it should be adopted only with the approval of medical and public health authorities. There is, so far, no other known means of mass treatment for the control of dental decay.

Chlorine Supply

A paper on "Chlorine Supply" by J. A. Logan, Sales Mgr., Mathieson Chemical Corp., New York City, was read by Ralph Carr, Engineer with

Open House at University Club

The food was plentiful and free *The customers were satisfied and happy*

Elements of Coagulation Demonstration

D. Paul Rogers Demonstrates Jar Test

"The Master" Marsdon C. Smith from Richmond explains a theory after class

Rogers points to flocculation effects of plain settling—R. J. Schatz assists

the Mathieson Corp. In summarizing the data presented in this paper, Mr. Carr reviewed briefly the early development and recent expansion of the chlorine industry of this country. Prior to 1940, not all available capacity was in use and new outlets were actively sought. Chlorine production capacity was enlarged to meet new and increased wartime demands.

While the present capacity of the chlorine industry is over one and one-half million tons of gas per year, the major portion of this production is not liquefied and shipped in commerce, but is used at the producing plant for the manufacture of other chemicals and materials. There is now a constant demand for all liquid chlorine available, and the largest tonnage users are generally the most attractive customers.

The demand for liquid chlorine in the sanitation field is considered relatively constant (on a yearly basis) but fluctuates considerably during various seasons of the year. Since water and sewage uses constitute a relatively small tonnage of the total production, and since relatively large numbers of containers are required for this tonnage because of seasonal demands, this outlet is not as desirable to producers as some other uses.

Among various factors cited which are prejudicial to the sale of liquid chlorine in the sanitation field are: local rules and regulations making this business less attractive than industrial sales; the shortage and greater cost of containers; the present high cost of building new chlorine producing plants; and the fact that cheap salt and electric power generally determine chlorine plant location (most industrial markets are near points of production) but sanitation demands are quite evenly spread around the country.

Chlorine producers recognize the vital necessity of supplying sanitation needs. They can supply chlorine for such purposes with greatest efficiency when consumers give ample advance notice of their needs and cooperate fully in the return of empty containers.

Service Extensions

Vance F. Rigling, Ch. Engr., Water Utilities Service Corp., Lemoyne, Pa., spoke on "Practices in the Extension of Mains to Suburban Areas." A more accurate title for this paper, the author stated, would be "THE REFUNDABLE DEPOSIT FOR MAIN EXTENSIONS AND ITS USE." Under present conditions of housing construction, many water main extensions bring such low returns that means have been sought for meeting the costs of extensions. The problem is one of excessive construction costs, sparse consumers, high operating costs, and inadequate return on the investment.

The author described methods which have been developed in answer to this problem, those involving the outright contribution by consumers to the laying of new extensions, or refunding methods. Refunding methods are generally based on the actual amount of revenue obtained in the first year of use, and usually vary from 3.5 to 7.0 times the amount of revenue. Approved methods of financing were recommended, and related functions such as cost records and financial bookkeeping were described. In order to prevent profit or loss which might occur in refunding methods, agreements may be made for either additional deposits from consumers or refunding differences by the utility.

It appears that this type of agreement is rapidly becoming the accepted form of agreement. Refunding methods are logical and have the approval of financial agencies. Considerable education is still needed to show that a main extension should carry itself, and this is the responsibility of the utility.

In discussion, following this paper, it was evident that the problem is one generally encountered. The utility is responsible for maintenance of new extensions if additional consumers are later added, it was stated. Several hundred such agreements are now in operation and are reported to work very well. In reply to a question concerning refundable agreements, it was pointed out that assessments may be prorated. Under refunding agreements, differential arrangements may be made by the water utility in order to provide larger capacity water mains than may be warranted by the present basic need.

Open House and Awards

As is customary at these annual meetings, awards are made for golf winners and for the best playing during the soft ball games. Also, at each session, door prizes are awarded to the lucky members whose names are pulled out of the hat.

The presentation of the Past President's Key to Mr. Tom Braman was made by a former Past President, Martin Flentje, Sanitary Engineer, American Water Works Co., New York City.

Candid Shots

Paul Hess takes notes at session

"Dick" Beckett reads Fred Allen's column to appreciative audience

On 10th Tee—"Jolly" Angell shows driving form

WHITE WATER TREATMENT AND RECOVERY

IV. Physical and Chemical Methods of Sludge Concentration*

by

WILLEM RUDOLFS AND A. J. PALLADINO

Chief and Research Assistant

RUTGERS UNIVERSITY, NEW BRUNSWICK, N.J.

IN A previous paper it was indicated that gases entrained in sludge impede settling and may cause flotation. To make maximum use of flotation phenomena, chemicals are required. Chemical coagulants aid floc formation, and the buoyant effect of entrained gases aids in the concentration of sludge at the surface of the liquid.

This paper records the effects of coagulants and pH on the concentration of white water sludge by flotation, the effects of inducing flotation by supersaturation and evacuation, and the results obtained by vacuum filtration.

Experimental Procedures

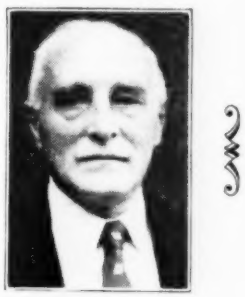
Flotation was accomplished by using calcium hypochlorite, by means of supersaturation with air using a high-speed mixer, and by evacuation. The vacuum filtration tests were accomplished with a 16 sq. in. experimental filter leaf covered by nylon filter cloth under a vacuum equivalent to 25 inches of mercury.

Effect of Coagulants and pH

Little additional reduction in sludge volume over and above that produced by plain settling alone was attained by coagulation of sludge at doses of 5 lb. per 1000 gal. of $Fe_2(SO_4)_3$, Fe Cl_3, lime and alum. A 29 per cent sludge volume reduction was attained in 1 hour with a lime dose of 180 lb. per 1000 gal. Doses below this amount resulted in no advantage over that attained by plain settling and in some cases resulted in larger volumes. Doses of 20 lb. per 1000 gal. of Fe Cl_3 caused no increase in concentration rates. The effect of lime was similar to the effect of Fe Cl_3.

The effect of pH on sludge volume reduction was small, a reduction exceeding 5 per cent being attainable only at extreme pH values and after 6 hours' settling time.

*Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, Department of Sanitation.



The Senior Author

Concentration by Flotation

Flotation processes in general require flocculation of the sludge particles and attachment of gas bubbles to the flocculated particles to cause flotation. Some types of save-all equipment concentrate fibre from white water by use of flotation processes. They involve saturation of the white water with air and subsequent release of air bubbles at a lower pressure. Chemicals are added to produce flocculation.

Flotation processes are particularly effective with sludges that settle very slowly. Hence, a great part of the experimentation with this technic was performed with sludges representing that portion of the white water which was discharged from the cloudy port of a vacuum filter save-all, consisting of fibres of small particle size. The sludge had a gel-like appearance and concentrated only slightly on standing. Flotation tests were also conducted on sludges from other paperboard mills. The evolution of gas bubbles from calcium hypochlorite in solution has been known to effect flotation of solids from sludge slurries.

1. Calcium Hypochlorite. Doses of calcium hypochlorite ranging from 50 to 1000 ppm. were added in a dry state to samples of sludge and the sludge volumes recorded at intervals up to 24 hours. Also, 20,000 ppm. doses were added to samples of this sludge with the pH adjusted from 5 to 1.0.

Maximum sludge volume reductions attained by flotation with 1000 ppm. calcium hypochlorite were: 15 per cent in 1 hour, 40 per cent in 4 hours and 50 per cent in 24 hours. With 500 ppm. doses the sludge volume reductions equalled one-half of those above, and doses below 500 ppm. yielded small and erratic results. Fig. 1 illustrates the advantage gained by flotation with 1000 ppm. of calcium hypochlorite over that attainable by plain settling.

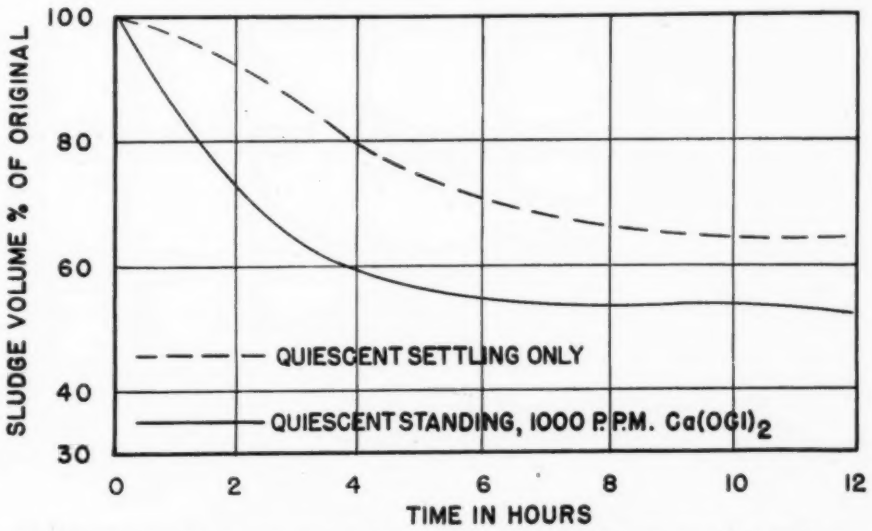


Fig. 1. Concentration Rate of Sludge Caused by Flotation with Calcium Hypochlorite Vs. Plain Settling.

Sludge volume reductions resulting from 20,000 ppm. doses did not exceed 20 per cent in 1 hour and tended to be slightly higher at the lower pH values.

2. Supersaturation with Air.

Supersaturation with air followed by quiescent standing showed a 35 per cent average sludge volume reduction in 5 minutes, 50 per cent in 15 minutes and 55 per cent in 1 hour. The turbidity of the effluent varied from 400 to 600 ppm. When the subnatant liquor was drained off after 15 minutes and the resulting sludge remixed rapidly, a total sludge volume reduction of 60 to 65 per cent was accomplished after an additional 15 minute period of standing, or a 2.8 fold increase in concentration. The sludge resulting from this latter process had a solids concentration of about 2.5 per cent and would not appreciably concentrate further upon being mixed once again. A small increase in concentration was effected by 100 ppm. hypochlorite doses. Greatest concentration occurred when the hypochlorite was added before mixing, but the turbidity of the subnatant liquor was least (100 to 150) when the chemical was added after mixing. Hypochlorite doses of 1000 ppm. were no more effective than doses of 100 ppm. The concentration by flotation effected only by high speed mixing of sludge is shown in Fig. 2.

Table I

Effect of Filter Aids on Vacuum Filtration Rate

Filter Aid	Filter Rate* gal./sq. ft./hr.	Computed Fiber removed, lb./sq. ft./hr.	Filter cake Thickness**	Filter cake % Moisture	Computed lb. water/ lb. fibre removed
None	14.4	1.68	1/32	79	3.8
Celite 512	20.2	2.35	1/8	70	4.7
Celite 503	25.0	2.91	1/8	69	4.5
Hyflo super cel	26.4	3.10	1/8	69	4.5
Celite 545	29.4	3.42	3/16	69	4.5
Lime	31.2	3.65	3/16	69	4.5

*Based on a 2 minute operating cycle.
**Thickness in inches
Paper tissue sludge concentration = 1.4%
Filter aid dose equal to sludge concentration in each case

The results attained by rapid mix flotation of sludge with an initial consistency of 0.45 per cent showed a 4.4 fold increase in concentration in 15 minutes. When the sludge was concentrated to twice its original consistency by 2 hours' settling before subjection to the flotation process, a 5.3 fold overall increase in sludge concentration was attained. However, the suspended solids concentration of the subnatant liquor was higher than that of the unaltered sludge.

The efficiency of this process was increased by use of calcium hypochlorite as a flotation aid and coincident pH adjustments to 6.0 and 5.0. Better results were obtained when the hypochlorite was added after, rather than before, the rapid mix. Best results were obtained with pH adjustment to 5.0 and a hypochlorite dosage of 5000 ppm., in which case, flotation yielded a sludge of 2.59 per cent consistency and a subnatant liquor to 200 ppm. suspended solids.

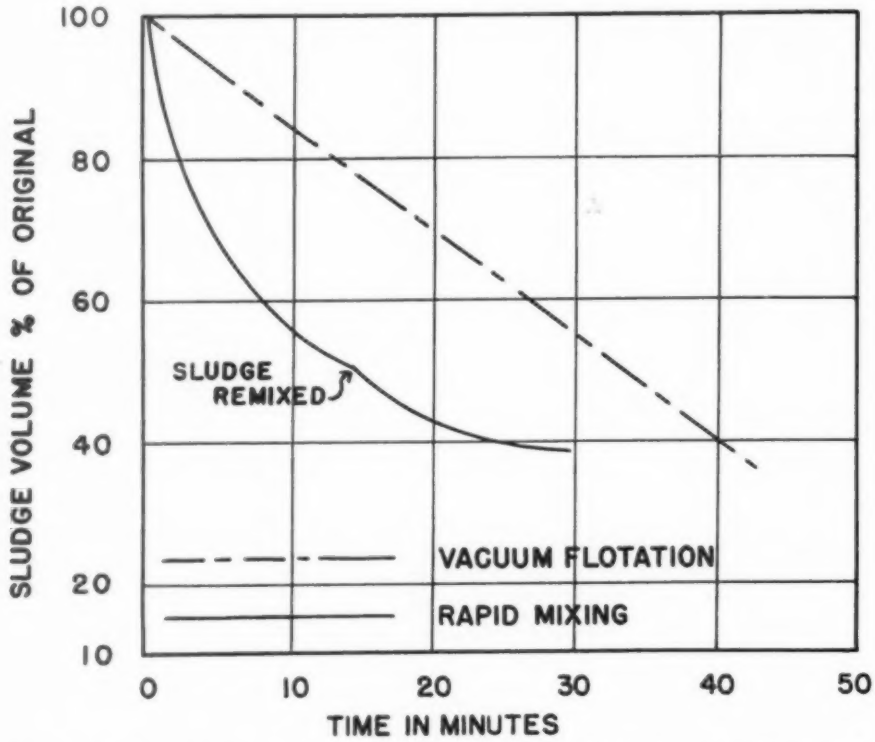


Fig. 2. Concentration Rates of Sludge Effected by Supersaturation with Air, by Rapid Mixing, and by Vacuum Flotation.

Because of expansion from air bubbles and froth, the sludge volume immediately after beating expanded (on the average) to 125 per cent of the original volume; in no case, however, was there more than 10 per cent expansion after 15 minutes' flotation.

3. Flotation by Evacuation of Air. An attempt was made to induce flotation by supersaturation with air, using 3 minutes of rapid mixing, followed by application of vacuum ranging from 5 to 25 inches of mercury. This process, if carefully controlled by increasing the vacuum slowly from 5 to 25 inches of mercury, was found to be effective in reducing the sludge volumes by 67 per cent in 30 to 45 minutes, but results were not readily reproducible. The maximum concentration rate of sludge produced by vacuum flotation is compared to that produced by rapid mix flotation in Fig. 2.

Vacuum Filtration

In the vacuum filtration of waste sludges some conditioning chemical or inert material is usually added to effect coagulation before filtration. Conditioning causes a more granular sludge mixture, thus increasing the filtration rate and resulting in a drier, more easily handled filter cake. Lime and alum and various types of diatomaceous earth were used, the former as coagulants and the latter as inert filter aids. Diatomaceous earth has particular applicability in the recovery of paper fibre for reuse, since it can be incorporated into the paper sheet as a filler material and thus effect a partial return of the recovery cost.

1. Sludge from Tissue. In order to determine the filter aid most beneficial to the vacuum filtration of sludge from a tissue mill, filter aids were added in doses equal to the solids concentration of the sludge (1.4 per cent), including Johns-Manville diatomaceous filter aids:—hyflo super cel, Celite 503, Celite 512, and Celite 545. These are in order of increasing particle size from 1 to 12 microns to 12 to 45 microns. Subsequently, lime and Celite 545

were added in graduated doses ranging from 5 to 200 per cent of the sludge solids concentration. The sludge samples were well mixed to assure even distribution of filter aid and were then submitted to vacuum filtration. To assure that the porosity of the cloth remained constant, it was washed between tests until it passed 600 ml. of clean water in 5 seconds. Precoat doses ranged from 1/16 to ½ lb. per sq. ft., yielding a precoating ⅛ to 3/16 inch thick.

Some results obtained (Table I) indicate that, of the filter aids used, Celite 545 and lime were most effective in increasing the vacuum filtration rate of sludge from tissue. Based on the two minute cycle rates, filtration rates of about 30 gal. per sq. ft. per hr. were attained. The corresponding weight of solids removed computed from the filtration rates and the sludge solids concentration was about 3.5 lb. per sq. ft. per hr. exclusive of filter aid weight.

The moisture content in the filter cakes obtained by use of filter aids was about 70 per cent compared to 80 per cent when no filter aids were used. However, the weight of water per unit weight of sludge solids removed was lower in the cake when no filter aid was used. These values were computed from the moisture content of the filter cakes on the assumption that the ratio of sludge solids to filter aid in the cake was 1 to 1. The cake thicknesses were ⅛ inch or greater when filter aid was used and were easily blown free of the cloth with compressed air.

The results of the tests comparing the effectiveness of various concentrations of lime and Celite 545, found to be the best filter aids of those previously studied, are depicted in Table II. A 15 per cent lime dose resulted in a filtration rate of 30 gal. per sq. ft. per hr. Higher lime doses caused no increase in this rate. With Celite 545, however, the filtration rate was directly proportional to the dosage, and a dose equal to 150 per cent of the sludge solids was required to result in a filtration rate of 30 gal. per sq. ft. per hr. Up to a dose of 100 per cent of the sludge solids concentration, lime yielded a higher filtration rate and a thicker cake of slightly higher moisture content than Celite 545. However, the pH of the effluents from lime treatment was above 11.0 with doses of 5 per cent or higher. Fig. 3 illustrates the filtration rates attained with varying quantities of lime and Celite 545.

The results of the tests to determine the number of cycles which could be accomplished before washing of the filter cloth was necessary when diatomaceous earth was used as filter aid showed that 8 cycles were accomplished before the filtration rate dropped significantly below 15 gal. per sq. ft. per hr. from the initial value of 20.4 gal. per sq. ft. per hr. Therefore, a 15 minute backwashing interval was adequate for maintenance of satisfactory filtration rates.

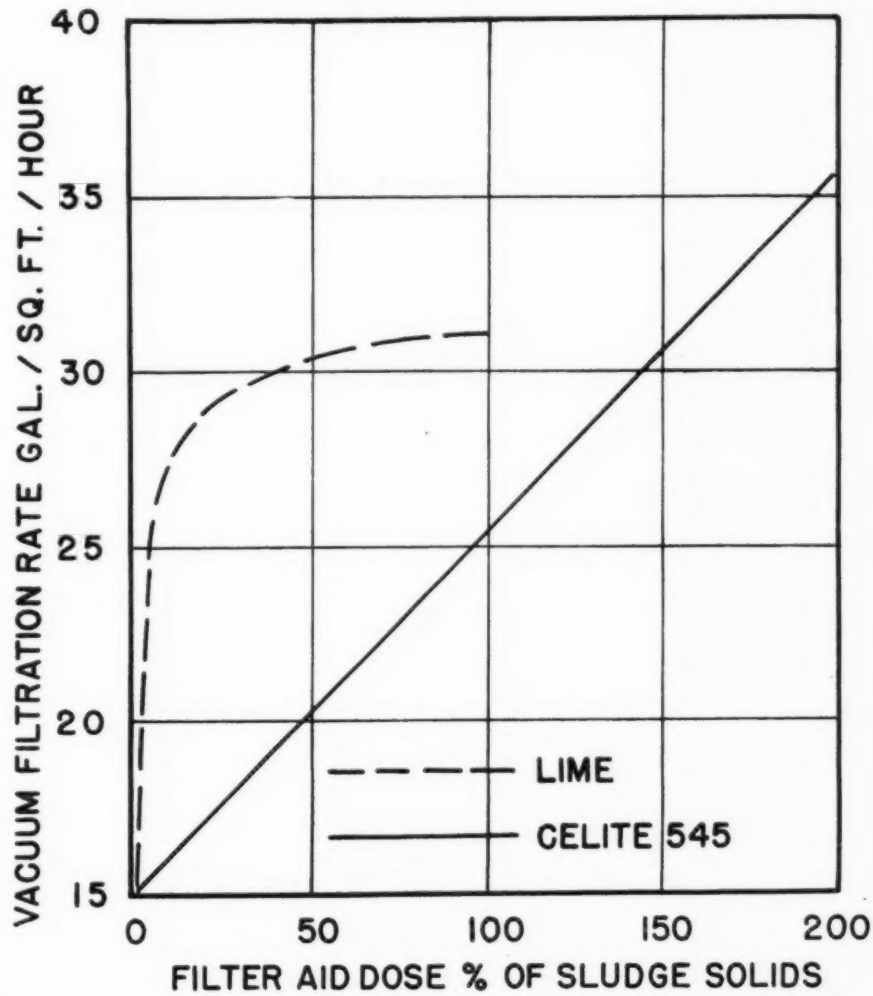


Fig. 3. Effect of Various Concentrations of Lime and Celite 545 on the Vacuum Filtration Rates of Paperboard Sludge.

Table II

EFFECT OF VARIOUS CONCENTRATIONS OF CELITE 545 AND LIME ON THE VACUUM FILTRATION OF SLUDGE

Filter Aid Dose *1	Filtration Rate *2 gal./sq. ft./hr.		Computed Fibre removed, lb./sq. ft./hr.		Filter Cake Thickness *3		Filter Cake % Moisture		pH Lime
	545	*lime*	*545*	*lime*	*545*	*lime*	*545*	*lime*	
0									
0		15.0		1.95		1/32		81	.....
5	16.8	26.4	2.18	3.43	1/32	1/8	78	79	11.3
15		30.6		4.00		1/8		78	11.9
25	17.1	29.4	2.22	3.82	1/32	1/8	76	77	12
50	19.8	30.0	2.58	3.90	1/16	1/8	71	75	12.1
75	19.2		2.50		1/8		71		
100	23.7	30.6	3.08	4.00	1/8	3/16	68	72	12.2
150	29.1		3.78		1/4		67		
200	35.2		4.57		1/4		67		

*1 Filter aid dose in % sludge solids
*2 Based on a 2 minute operating cycle
*3 Thickness in inches

Use of a precoat of 0.25 to 0.5 lb. per sq. ft. of diatomite filter aid caused an increase of 10 to 20 per cent in the filtration rate of the sludge mixtures, with turbidities in the effluents varying from 60 to 100 ppm. and moisture in the cake practically similar to those in the cake without diatomaceous earth.

2. PAPERBOARD SLUDGES. Results obtained with diatomaceous earth as a filter aid for paperboard sludges indicate that the filtration rate was not affected by diatomite filter aids.

Filtration tests on sludge of 0.80 per cent solids with lime added as a coagulant in graduated doses ranging from 100 to 10,000 ppm. failed to produce a filter cake thicker than 1/64 inch. This sludge was subsequently concentrated to 1.3 per cent by 2 hours' plain settling and to 2.0 per cent by flotation. The results of filtration tests following addition of 5000 ppm. lime to these consistencies, summarized in Table III, indicate that the filtration rate dropped off at the higher consistencies, but the weight of solids deposited in the cake increased with increasing solids concentration. Also, a concentration of 2 per cent was necessary to produce a filter cake approaching ⅛ inch thick. Lime doses below 5000 ppm. were ineffective with 2 per cent sludge in producing a cake of thickness approaching ⅛ inch. A filtration rate of 20 gal. per sq. ft. per hr. corresponding to a solids removal of 3.3 lb. per sq. ft. per hr. was obtained with lime doses of 5000 ppm. (25 per cent of the sludge solids concentration).

Table III

Effect of Concentration on the Vacuum Filtration Rate of Sludge

Sludge Conc. %	Filtration Rate* gal./sq. ft./hr.	Filter Cake Inches	Computed Solids removed—lb./sq. ft./hr.
0.80	27.3	1/64	1.85
1.3	22.2	1/32	2.40
2.0	20.1	3/32	3.35

5000 ppm. lime added as coagulant in each case
*Based on a 2 minute operating cycle

The results of vacuum filtration of sludge concentrated by flotation to 3.0 per cent solids and coagulated with small alum preconditioning doses are shown in Table IV. An alum dose of 150 ppm. effected a filtration rate of 22 gal. per sq. ft. per hr. corresponding to a solids removal of 5.5 lb. per sq. ft. per hr. This represented a 35 per cent increase in filtration over that attained with no coagulant. Coagulant addition was necessary to produce a cake approaching ⅛ inch in thickness.

Discussion

Flocculation, addition of coagulant and pH adjustment were found to have negligible effects on the concentration by settling of white water sludges. These results are similar to those of experiments with activated sludge, showing that stirring had only a very slight effect on the concentration rate.

Flotation of white water sludge was found to be most effective when accomplished by evolving air bubbles following the supersaturation process. Use of calcium hypochlorite in connection with this method of sludge concentration increased the efficiency of the process by virtue of a more prolonged evolution of bubbles of gas. Theoretically, the reaction which occurs upon addition of hypochlorite is as follows:—In water, the hypochlorite releases chlorine gas, which reacts with the water to form HCl and HOCl (hypochlorous acid). The HOCl then reacts with the water to form additional HCl and to release nascent oxygen in an effervescence of bubbles. It was found in this investigation that this reaction would occur when the sludge was adjusted to pH values below 7. At pH values of 5 to 6 the reaction resulted in a prolonged evolution of tiny bubbles, concentration by flotation and reduced turbidity of the subnatant liquor.

The combination of air supersaturation and calcium hypochlorite effected concentrations of both paper tissue and paperboard sludges to about 2.5 per cent solids concentration. Calcium hypochlorite contributed to the concentration of paperboard sludges to a greater degree than in the case of paper tissue sludges.

It was necessary in achieving supersaturation by high speed mixing that a substantial vortex be formed so that entrainment of air might be considerable. Except in those cases of paper mills maintaining high speed beaters, the method of supersaturation with air is rather impractical. However, supersaturation can be accomplished by other means. The Sveen-Pederson and ADKA save-alls, which recover fibre by supersaturation with air and flotation of solids from white water, could be effectively used in thickening sludge.

The vacuum flotation technic, which depends for effect on the release of air bubbles due to reduced pressure, does not readily produce reproducible results. This process has been used for the flotation of cannery wastes. It was found that vertical counter currents, however, were frequently formed which hindered effective concentration.

Based on the two minute cycle employed in the vacuum filtration tests, a filtration rate of 30 gals. per sq. ft. per hr. was attained with paper tissue sludge of 1.4 per cent solids when lime was added as a coagulant in a dosage equal to 15 per cent of the sludge solids weight (2100 ppm. on a wet basis). This corresponds to a computed solids removal of 4 lb. per sq. ft. per hr. It required about ten times as much Celite 545 to accomplish the same results. The filtration rate increases linearly with the addition of diatomaceous earth, because this filter aid exerts merely a physical effect.

Lime reached a maximum coagulating effect at a dose of 2100 ppm. and this did not increase appreciably with higher dosage. Use of lime is recommended when the filter cakes are to be disposed of. For reuse of fibre, Diatomite filter aids are more appropriate.

It was necessary in the case of paperboard sludges that the sludge slurry be of 2 per cent or higher concentration to obtain a cake about ⅛ inch or more thick. This concentration could be attained by settling, but was attained by flotation. Alum seems to be more effective than lime in preconditioning paperboard sludges for filtration. Filter aids (diatomaceous) were not effective.

Table IV

Effect of Alum on the Vacuum Filtration of Sludge Concentrated By Flotation to 3.0% Solids

Alum dose* ppm.	Filtration Rate** gal./sq. ft./hr.	Filter Cake		Computed Solids removed—lb./sq. ft./hr.	Effluent pH
		Inches	% Moisture		
None	16.5	1/16	78	4.05	8.3
75	19.5	3/32	75	4.88	8.2
150	22.2	3/32	75	5.55	7.7

*Alum dose in terms of Al.
**Based on a 2 minute operating cycle.

In the case of sludge with 3 per cent solids, a 150 ppm. dose of alum resulted in a computed solids removal of 5.5 lb. per sq ft. per hr. The pH of the effluent was 7.7 and only little changed from that of the original sludge. A 5000 ppm. lime dose, necessary to produce a ⅛ inch thick cake, resulted in solids removal of 3.3 lb. per sq. ft. per hr.; the pH of the effluent, however, was about 11.

Summary

Studies were made on the effect of flotation induced by high speed mixing and chemical treatment, and the

effect of coagulants on dewatering of concentrated sludges. Two types of white water sludges were used, namely, tissue paper and paperboard sludges. In general, settling or flotation and vacuum filtration applied successively could decrease the moisture content of the sludge from 99-99.5 to about 70 per cent, thus decreasing the water to solids ratio from 99 to 1 to 2.3 to 1.

The buoyant effect of gases evolving can be greatly increased by supersaturation, artificially induced, causing sludge concentration by flotation rather than by settling.

Flotation is more effective than gravity settling in the dewatering of white water sludge.

Lime was found to be a better filter aid than diatomaceous earth in the vacuum filtration of paper tissue sludge. The latter, however, is applicable in cases where reuse of fibre is desired.

Alum is more effective than lime in vaccum filtration of paperboard sludges.

It is necessary to have a slurry of at least 1.5 to 2.0 per cent solids by virtue of the sludge solids concentration per se or by virtue of filter aid addition in order to obtain a filter cake of sufficient thickness to make vacuum filtration feasible.

METHODS OF CLASSIFYING COMMUNITIES FOR FIRE INSURANCE RATINGS*

by

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"Municipal classifications are determined by the application of the Standard Grading Schedule for Grading Cities and Towns in the United States with reference to their fire defenses and physical conditions, after field inspection and test of the local facilities. The grading schedule is based on the premise that a community with no protection would have a deficiency grading of 5,000 points, while a perfect community would have a deficiency grading of zero points. The chief items that are taken into consideration are Water Supply, Fire Department, Fire Alarm System, Police, Building Laws, Fire Prevention and Structural Conditions. The maximum number of points chargeable to each of these items are as follows:

Water Supply	1,700
Fire Department	1,500
Fire Alarm System	550
Police	50
Building Laws	200
Fire Prevention	300
Structural Conditions	700
Total	5,000

"The quantity of water required for fire protection purposes in each community varies with the structural conditions which constitute the principal mercantile district or high value area and in average communities with normally anticipated structural conditions the required flow is determined by the formula:

$$G = 1020 \sqrt{P} (1 - .01 \sqrt{P})$$

where G equals gallons per minute, and P equals the population in thousands. The fire flow thus obtained for each community constitutes the basis for the grading schedule set up for that community in that most items in the schedule have a direct relationship to this feature of the supply. However, in all communities special conditions such as extensive flammable liquid storage or hazardous manufacturing activities may demand greater quantities of water in these special areas.

"Generally speaking, however, fire flow demand for principal mercantile districts or high value districts range from 1,000 g.p.m. for a period of four hours for a normal community of 1,000, to 12,000 g.p.m. for a period of ten hours for a normal community with a population of 200,000. The required fire flow in residential districts depends upon the character and congestion of the buildings. Sections where structures are small and of low height, with about one-third of the lots in the block improved with buildings, require not less than 500 g.p.m. With larger or higher buildings, up to 1,000 g.p.m. is required, and where the district is closely built on, with buildings approaching the dimensions of hotels or high value residences, 1,500 to 3,000 g.p.m. is required, with up to 6,000 g.p.m. necessary in densely built sections of three stories and higher.

"These requirements merit some explanation, however, in that they indicate the quantity of water which authorities believe should be available in these respective districts, but it being recognized that lesser quantities are of appreciable value in fire fighting, the general practice is to accept for recognition for the establishment of a protected area, all hydrants which can be depended upon to deliver a minimum of 200 g.p.m. for a period of one hour. Hydrants meeting this requirement entitle the communities in question to a protected rate for all properties within 500 feet.

"Careful consideration in all cases should be given to hydrant spacing because the value and capacity of the water system is entirely dependent on the availability of the fire hydrants. In general, hydrants should be spaced so as to serve maximum areas of 40,000 to 120,000 square feet, depending on the structural conditions in the particular area. These area requirements, however, may be modified in residential districts consisting of single streets or rural roads without block development where buildings are normally on 100-foot lots, to provide a coverage of 120,000 square feet per hydrant by considering a width of protection of 200 feet and a spacing of 600 feet.

"In setting up municipal grading schedules the first consideration is given to the 'limiting factor' of the water system in that it is readily recognized that a hydrant or a system of hydrants might deliver from 1,000 to 5,000 g.p.m. whereas the capacity of the system over and above the consumption demands for a period of hours might be restricted by a supply works capable of delivering, for instance, only 500 gallons per minute, offset to only a slight extent by storage of 100,000 to 300,000 gallons, in which case the delivery of hydrants would indicate the limiting factor of the system. In other instances the capacity of the supply mains from the source of supply might be such that the initial flow at hydrants due to proximity of storage could not be maintained, or in other instances pumping equipment could be of such capacity as to be unable to maintain the initial hydrant delivery after depletion of storage. All of these features are studied and analyzed by the rating organization engineer during the survey and before proceeding with the grading schedule make-up."

*Presented before the Northeastern Water Works Co. Group Meeting in Camden, N.J.

THE BACTERIOSTATIC EFFECT OF METHYLENE BLUE ON THE B.O.D. TEST

Advantages in Checking the Activity of Nitrifying Organisms

by
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THE loss of oxygen measured in the B.O.D. test on polluted liquids during the usual period of 5 days at 20°C. may be caused by two entirely different groups of reactions, namely—

1. The oxidation of carbonaceous organic matter to carbon dioxide and other products.

2. The oxidation of ammoniacal nitrogen to nitrite and nitrate.

With sewage samples the 5-day loss is almost entirely confined to the first group. On the other hand in the case of well-clarified effluents which have residual ammoniacal nitrogen the loss can be shown on occasion to be almost entirely due to the second group of reactions. The Royal Sewage Commission's experts were aware of this in 1913 when the Commission sponsored the test as a standard for effluents[1]. Since then many have found the test an exceedingly erratic index of purity once the initial stages of purification have been passed.

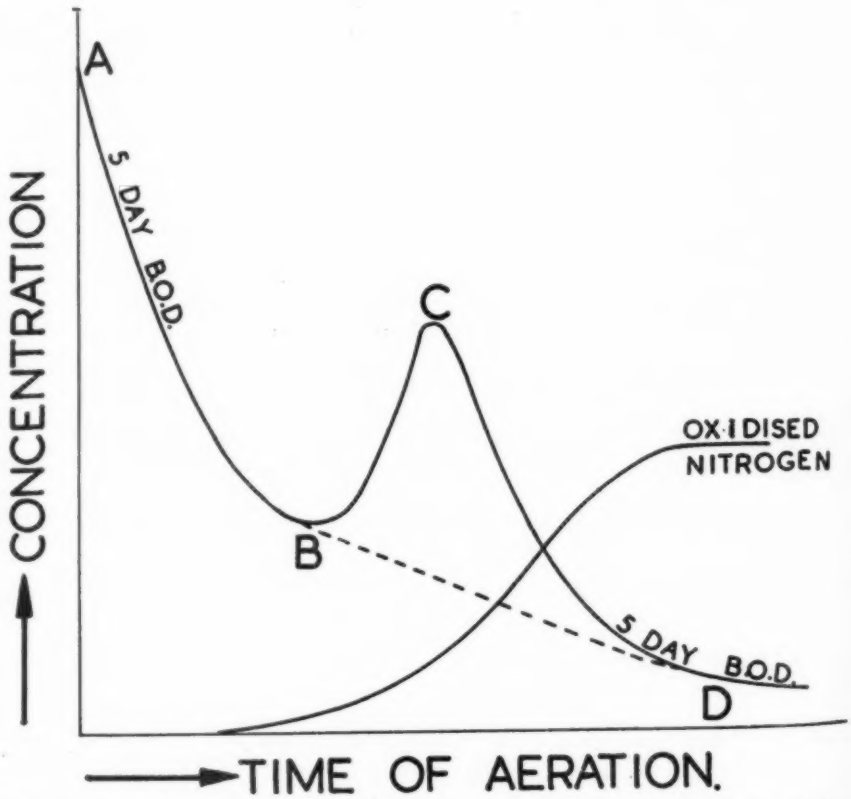
In the author's case an unexpected shock was received in 1924 when the test was used to follow the course of purification of sewage by activated sludge, employing the fill and draw procedure. Although the appearance and oxygen consumed values of the supernatant from the mixed liquor steadily improved, the B.O.D. results followed an irregular course as shown in the accompanying graph. On occasion the peak C on the graph was almost equal to A. It was ascertained that nitrification was responsible for the area BCD on the graph.

The Effect of Inhibitors Explored

The first paper on the bacteriostatic effect of dyes[2] appeared about this time and the opinion was formed that some dye must exist which would inhibit nitrification in suitable dilution while allowing the more robust carbonaceous oxidation to progress as usual. The possibility was re-examined at intervals for the next twenty years. These preliminaries indicated that the difficulty lay not so much in finding a dye with an effect on nitrification as in finding one that would cause no difficulty in the determination of dissolved oxygen. Finally it was found that methylene blue was destroyed during the acid-permanganate phase of the Rideal-Stewart modification of the Winkler test to such an extent that the subsequent stages of oxygen estimation were not prejudiced by the previous existence of the dye. It was then demonstrated that nitrification could usually be suppressed for a longer period than five days[3].

It has of course always been possible to attempt to follow the nitrogen changes during incubation by analysing duplicate bottles. In the writer's experience the results have often been far from definite. For instance there may be a loss both of ammoniacal and nitrate nitrogen with a resulting gain in the nitrite. In such cases it is likely that the suspended matter at the bottom of the bottle is reducing nitrate while oxidation of ammoniacal nitrogen to nitrite is occurring at the top. Any stabilization of organic matter at the expense of oxidized nitrogen reduces the amount of dissolved oxygen absorbed and thereby interferes with the primary purpose of the test. It was therefore recognized with great satisfaction that the addition of methylene blue appeared to inhibit denitrification as well as nitrification. It was, for instance, found that bottles containing methylene blue *never contained any nitrite nitrogen after incubation.*

It was at once noticed that absorption-time curves were much more reg-



B.O.D. Results in Relation to Nitrogen Oxidation in Activated Sludge Effluents.

ular in the presence of the dye. This might be expected from the absence of the disturbing elements of nitrification and denitrification. It is interesting to recall that Phelps discovered the monomolecular law for the course of dissolved oxygen absorption[6] from the results of the stability test with methylene blue. The writer has much experience of formulating absorption-time curves[4] and can vouch that success is easier in the presence of methylene blue. Phelps was unconsciously restricting his observations to the carbonaceous reactions to which the law applies. It is implied in a review[5] of Phelps' book[6] that methylene blue does not interfere with nitrification. The writer's experience is exactly to the contrary.

Since the preliminary brief report was submitted for publication in July 1947 more experience has been gained with the addition of the dye. It has become clear that the addition of methylene blue is capable of lowering the carbonaceous absorption (L in terms of the usual symbols) by from 5 to 20 percent. As nitrification is never appreciable in 5 days at 20°C. it is possible to meet this finding by recommending that the modified test should not be applied to sewage samples. There is no evidence that the more stable organic matter of effluents liable to nitrify is affected by the dye. It is possible to recommend the use of the methylene blue modification only when the oxygen consumed figure has been reduced by about 70% by purification or when tests carried out for the purpose indicate that nitrification does in fact occur during incubation. A high ratio (over 2.5) for the 5 day/2 day absorptions is a useful indication that nitrification occurs. It is also now felt that the amount of dye should be based on the total volume of the dilution rather than on the volume of the diluting water. The concentration of the dye in the liquid incubated is therefore 3.0 parts per million as against 1.33 in the A.P.H.A. stability test[7].

Test Procedure

Add methylene blue to the diluting water equivalent to 6.0 ml. of a 0.05% solution per litre of dilution. Proceed as usual with the Rideal-Stewart modification of the Winkler determination of dissolved oxygen. The destruction of the typical colour of methylene blue is easily observed during the acid-permanganate stage. It may be necessary to add a little more permanganate than usual. The potassium oxalate must not be added until the colour is the typical red permanganate shade. There is no difficulty whatever in this for a normal eye.

Discussion

Other reports have appeared on the elimination of nitrification during the B.O.D. test.[8] [9] It is believed that the treatments recommended are too drastic and in particular that reseeding does not lend itself to standardization.

It is hoped that the suggested method will be tried out by others on their partly purified and final effluents so that the value of the "carbonaceous" B.O.D., thus derived, can be judged over a wide range of circumstance. It is suggested that the bacteriostatic effect on nitrification by other dyes also be examined.

It is argued with some justification that nitrification may occur in the stream and therefore if it occurs in the test it must be accounted against the sample. There is, however, no means of knowing how far the nitrification recorded in the test would occur in the stream. Nitrification in the incubator is sensitive to every detail of the technique such as degree of dilution. The carbonaceous stage is not so sensitive by a long way and it will be generally admitted to be a more serious kind of loss of oxygen. It is in every sense irreversible, except in a certain sense in the presence of algae, while oxygen can be recovered from oxidized nitrogen before putrefaction occurs. There is in short every reason for accounting separately for the two kinds of oxygen loss.

It is suggested that ultimately it may be advisable to measure B.O.D. under two sets of conditions, i.e.—

a. when nitrification is suppressed.
b. when the dilution is seeded with an active nitrifying culture.

This would give some idea as to what might happen on discharge into a stream in which nitrification is actively occurring.

Heukelekian of the New Jersey Expt. Station, has shown that the two stage course of oxygen absorption may be due as much to lack of suitable organisms at the beginning of incubation as to any other reasons. Suppression of nitrification should be a sufficient guide in plant practice but both could usefully be employed in stream pollution studies.

The writer has experimented with mixtures of samples which do and do not nitrify on incubation and has invariably found that the absorption of the mixture is considerably greater than that calculated from the individual absorptions of the constituents of the mixture. This is regarded as confirming Heukelekian's conclusions.

Two other methods of reducing nitrification exist. These are as follows:

(1)—Using a lower temperature of incubation which tends to defer the onset of nitrification.

(2)—Using a shorter period of detention. The writer has already suggested this.[4]

Summary

The addition of 3.0 ppm. of methylene blue before incubation practically eliminates nitrification and denitrification in the B.O.D. test when applied to effluents and river waters which have a tendency to nitrify.

Acknowledgment

Thanks are due the Sewage Disposal Committee and Mr. A. R. Stone, Manager, of the Nottingham Corporation for permission to publish this paper.

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(6) E. B. Phelps. "Stream Sanitation," p. 65. (John Wiley, N.Y.)

(7) "Standard Methods," Am. Public Health Assoc. 1946, 144.

(8) Sawyer and Bradney, "Modernisation of the B.O.D. Test." *Sew. Works. J.* 1946. XVIII, 1113.

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Indiana Industries on Lake Michigan Agree to Spend $15,000,000 in Remedying Pollution

More than $15,000,000 will be spent by Indiana industries in the Lake Michigan area for sewage disposal improvement, if a final settlement comes out of the agreement reached recently between representatives of Indiana and Illinois on methods of ending pollution in Indiana streams emptying into Lake Michigan.

The conference was held at the Statehouse in Indianapolis to discuss a suit filed by Illinois against Indiana in the United States Supreme Court five years ago. The plan agreed upon will be submitted to the U. S. Supreme Court for approval and final settlement.

Comments of the Editors

Need Water Pipe? Write Mr. Truman

The many water works men who have had to wait months on months for water pipe since the demise of the War Production Board, allocations, and priorities, will read the following Associated Press story with mixed reactions.

Mrs. Paul Oudrey of Hillsboro, Ill., was having difficulty last summer buying water pipe, so she sat herself down and wrote of her situation to President Truman.

The housewife explained that she had a modest home some 700 feet from the nearest city water main, a muddy well that often went dry and three children that must be kept clean. "Every wash day is tear day for me," she added.

Her letter wound up in the then recently established Office of Industry Co-operation which is within the Department of Commerce. It landed on the desk of a steel and iron company official on loan to that agency. He made the necessary arrangements, and soon Mrs. Oudrey learned that a truck load of pipe, enough for the Oudrey's and also their three neighbors to connect to the city water main, was enroute to Hillsboro.

While we have not checked this story, it being an A.P. release gives it some authenticity. This same Office of Industry Co-operation is the agency which was established in the Department of Commerce with the objective of getting leaders of industry together for the purpose of setting up some form of a voluntary allocation and priorities system for basic materials which have been in short supply, amongst the most important being pig-iron and steel. In other words the idea was to develop a form of voluntary War Production Board plan and procedure for industry by industry which procedure was to be conducted as a co-operative, self-protective, and more or less patriotic enterprise. Like many others, the A.W.W.A. headquarters office and Executive Committee had high hopes of the success of the program set up by the Office of Industry Co-operation. However, much time has passed since the agency was established, and much effort has been made by A.W.W.A.'s headquarters office to secure relief for the water works industry which must wait months and months for pipe deliveries. The disappointment has been great. Still the water supply industry has been unable to secure the quantity of water pipe and fittings needed to bring water supply systems up to their pre-war status in respect to adequacy of water service.

Perhaps if water works men (big and little) would "take pen in hand," as did Mrs. Oudrey, and write *directly* to the President, explaining their situations and what it is meaning to their communities and people in restricted water use, sub-standard service and deficient fire protection; and, most importantly, raising the question of what is to be expected if another war load is to be thrown on their systems, which they haven't yet been able to bring up even to present day peacetime requirements, some good might come of it.

It doesn't cost much either in money or time to get off such a letter, which in sufficient numbers will make a worth-while imprint somewhere in Washington. At least the writer of the letter will have the satisfaction of being on record as having placed his situation, and that of his community, before the highest authority in the Nation's government—one who can ill afford to be accused of having ignored the needs, comfort or safety of the general public in *any* community.

A Revitalized N.E.W.W.A.

In this issue is an account of the 1948 Annual Convention of America's oldest association in the water supply field—the New England Water Works Association.

The 1948 convention of this association, held in New York City, was not outstanding in regards to attendance, for there have been several N.E.W.W.A. conventions in Boston which produced a higher attendance record. However, to this observer the 1948 convention gave one the impression that this venerable association is showing evidence of revitalization. In fact, the 1947 convention and monthly meetings held during the past winter in Boston, and ending the season with the Spring Outing in Swampscott, Mass., have also given evidence of the revitalization of what not so many years ago was referred to as an "Old Man's Association." It was, in fact, becoming just that, as adjudged by the average age of membership and member losses. Also the new member record was going from poor to worse.

Then, something happened to N.E.W.W.A. the year that it held its first convention at Poland Spring, Me. There, the Fancy Dress Ball proved to be a veritable "fountain of youth" and N.E.W.W.A. became years younger again.

However, it takes more than a good convention to keep an association alive and healthy. N.E.W.W.A. badly needed and got a new secretary—"Jo" Knox of the Mass. State Dept. of Health. It needed to do something about getting in more new members, and younger members. It did that. It needed to do something concrete for the superintendents. It did that through arranging a series of class-room lectures on hydraulics—theory, and examples of practical application in water works operation. These one hour lectures and demonstrations were given by Professor Russell of M.I.T. in what was termed the Water Works School, held in conjunction with the regular monthly meetings in Boston.

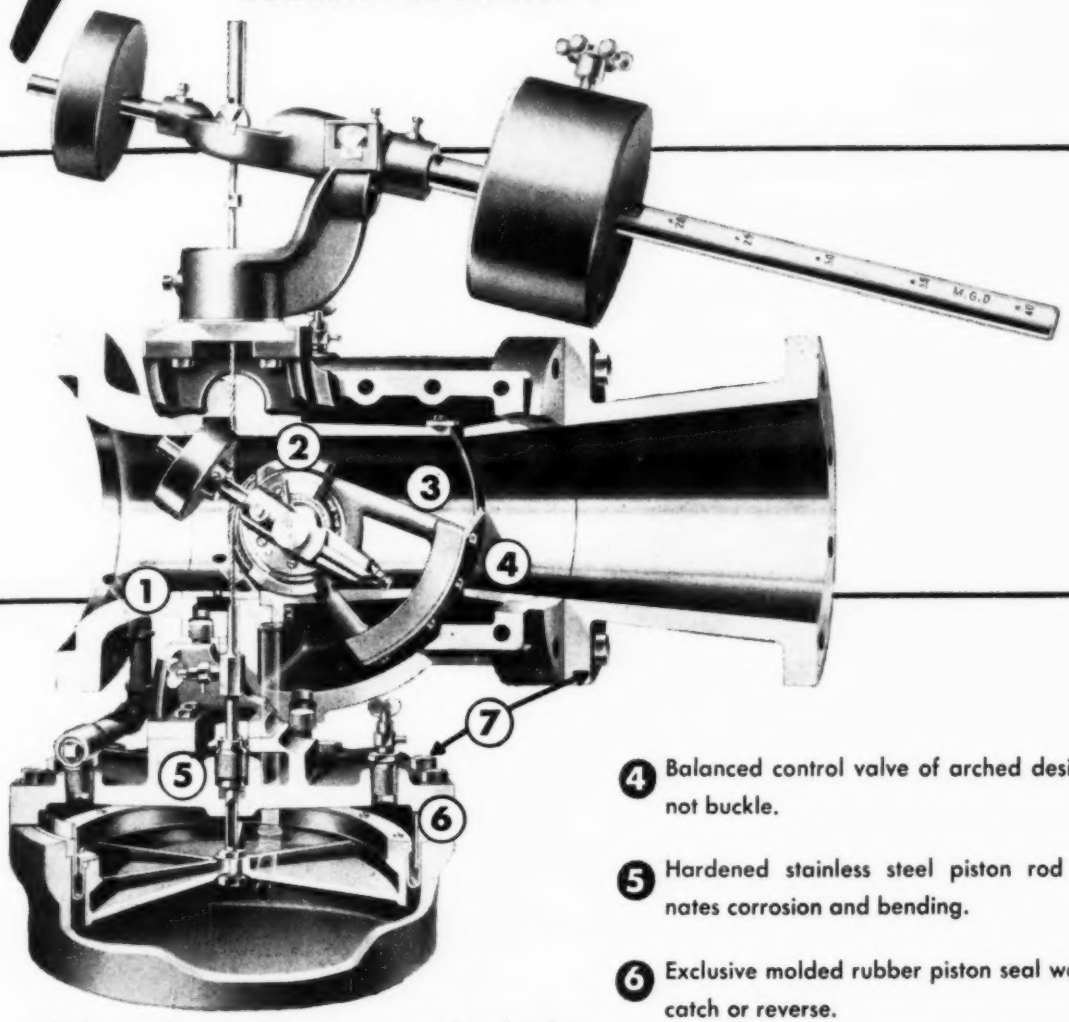
Nothing that an association can do to improve its general health and value to its members can equal the services of a capable and energetic secretary, and N.E.W.W.A. has made an excellent choice in the drafting of "Jo" Knox, who sacrificed his position in line for the presidency when accepting the post of secretary. We refer to his being drafted because the position is only a part time one and the pay is not at all commensurate with the time and effort required for the job.

The effects of "Jo" Knox's work are beginning to be noticed in N.E.W.W.A. The membership records of the past two years, which show an increasing number of new members and fewer losses, is but one indication. The program quality is another. Then, too, last year at the helm of the association was that vigorous superintendent of the Nashua, N.H. water works, Don Calderwood, believed to be the youngest N.E.W.W.A. president on record. The team of Calderwood and Knox got things done and also ended the year with $1200 in the black for the year, whereas the Budget Committee for 1948 had anticipated operations for the year at a net loss of $1,000, and had proposed a deficiency budget.

L. H. Enslow

7 GOOD REASONS

why more engineers, who demand the best in water works rate controllers, are specifying . . . "equal to Builders Model RCE":



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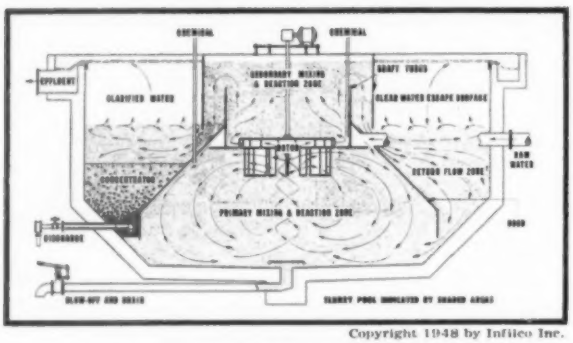

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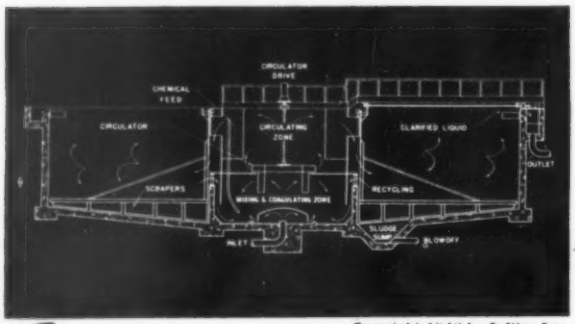

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (39 U. S. C. 233)

Of *Water and Sewage Works*, published monthly at Mount Morris (Ogle County), Illinois, for October 1, 1948.

1. The names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Edward S. Gillette, 22 West Maple St., Chicago 10, Ill.

Editor, L. H. Enslow, 155 East 44th St., New York 17, N. Y.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as those of each individual member, must be given.)

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L. H. Enslow, 155 East 44th St., New York 17, N. Y.

H. P. Gillette, 22 West Maple St., Chicago 10, Ill.

Winifred Gillette, 1125 Oak Grove Ave., San Marino, Calif.

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Mrs. R. W. Hume, 303 South Stone Ave., La Grange, Ill.

Provident Trust Co., 17th and Chestnut Sts., Philadelphia, Pa.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

None.

4. The two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

EDWARD S. GILLETTE,
Publisher.

Sworn to and subscribed before me this 21st day of September, 1948.

CLARE MEHL,
Notary Public.

(Seal)

(My commission expires Dec. 18, 1948.)

MEETINGS SCHEDULED

OCT. 25-26—RICHMOND, VA. (Hotel John Marshall)
Virginia Section A.W.W.A. Sec'y, W. H. Shewbridge, 708 State Office Bldg., Richmond 19, Va.

OCT. 25-29—STATE COLLEGE, PENNA. (Nittany Lion Inn)
Pennsylvania State College Water Works Operators' School. Director, R. E. Stiemke, Dept. of Civil Engineering, State College, Pa.

OCT. 26-27—SPRINGFIELD, ILL. (Leland Hotel)
Illinois Water Works Operators' Association. Sec'y, C. E. Corrington, Clinton, Ill.

OCT. 27-29—RIVERSIDE, CALIF. (Mission Inn)
California Section A.W.W.A. Sec'y, H. C. Medbery, Water Department, 425 Mason St., San Francisco, Calif.

OCT. 28-29—LA CROSSE, WIS. (Hotel Stoddard)
Wisconsin Section, A.W.W.A. Sec'y, L. A. Smith, City Hall, Madison, Wis.

NOV. 1-3—OTTAWA, CAN. (Chateau Laurier)
Canadian Institute on Sewage & Sanitation. Sec'y, A. E. Berry, Ontario Dept. of Health, Parliament Bldgs., Toronto, Ont.

NOV. 4-6—ATLANTIC CITY, N.J. (Madison Hotel)
New Jersey Section, A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N. J.

NOV. 8-10—ASHEVILLE, N.C. (Hotel George Vanderbilt)
North Carolina Section A.W.W.A. Sec'y, G. S. Moore, Supt. Water & Light, Albemarle, N. C.
and
North Carolina Sewage Works Association. Sec'y-Treas., G. S. Moore, P. O. Box 125, Albemarle, N. C.

NOV. 8-12—BOSTON, MASS. (Sessions-Mechanic Bldg.)
American Public Health Association. Sec'y, Dr. Reginald M. Atwater, 1790 Broadway, New York 9, N. Y.

NOV. 18-20—PANAMA CITY, FLA. (Hotel Dixie Sherman)
Florida Section A.W.W.A. Sec'y, S. K. Keller, Box 151, Clearwater, Fla.

DEC. 6-8—AUGUSTA, GA. (Sheraton Bon Air Hotel)
Southeastern Section A.W.W.A. Sec'y, W. T. Linton, State Board of Health, Wade Hampton Office Bldg., Columbia, S. C.

DEC. 8—WATERVILLE, ME.
Maine Water Utilities Association. Sec'y, Earle A. Tarr, Supt., Water District, Winthrop, Me.

MAY 30-JUNE 3, 1949—CHICAGO, ILL. (Stevens Hotel)
American Water Works Association Annual Conference. Exec.-Sec'y, Harry E. Jordan, 500 Fifth Avenue, New York 18, N. Y. (All reservations will be cleared through the A.W.W.A. office. Reservation forms will be mailed to members after November 1.)

Again We Say...

"BETTER BUILT FOR BETTER SERVICE"

For nearly seventy years Layne Well Water Systems have been recognized as the world's finest, but now and then we like to remind our friends—and ourselves of the reasons why. From pump head to screen point, every single part of a Layne Well Water System is definitely "Better Built for Better Service." Maintaining that highly essential standard, especially during material shortages, has not always been an easy task, but not once has a compromise been made.

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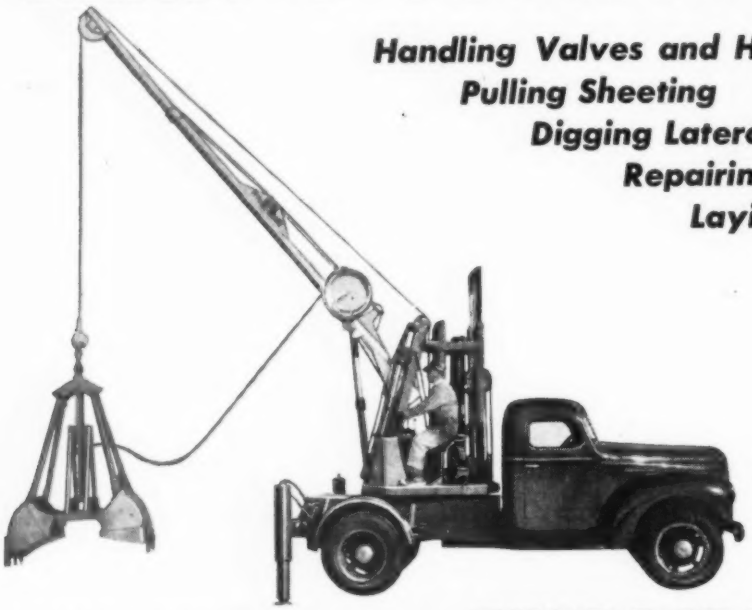

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Handles More Jobs—More Rapidly More Economically Than Any Other Crane

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Extends and retracts maximum load under hydraulic power at any boom angle.

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BUILT IN 2 SIZES

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The Hydrocrane is completely hydraulic — hydraulic finger-tip control telescopes, raises, and lowers the boom, sets the outrigging, hoists the load, swings the boom 370°, and opens and closes the bucket without the operator leaving his seat.

It's the simplest crane on the market — no clutches, drums, gears, brakes; only one engine powers the truck and crane — thousands of parts have been eliminated. That is why your initial investment is lower, operating costs are lower, and maintenance costs are far less than any other crane—enabling you to handle more jobs, faster, cheaper and more profitably.

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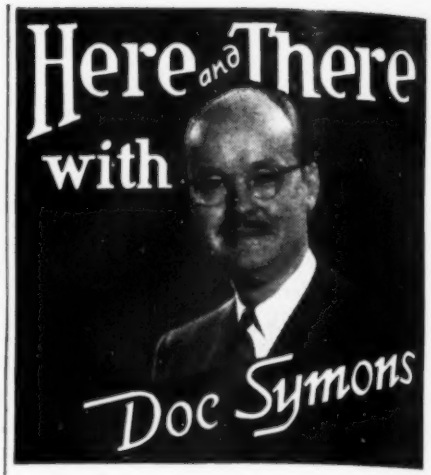


H.T.M.A.—And this is that month when all good men should come to the aid of their party. When election day arrives I shall be in Canada, discussing politics with my Canadian cronies. —But I've already cast my ballot for my presidential choice.

Speaking of politics, I don't care what yours is, was, or will be but I do think you ought to read a book called, "Our Unknown Ex President," by Eugene Lyons.

* * *

While I'm on the subject of books, I'm looking forward to reading Bellamy Partridge's new novel, "Big Freeze", which is the story of the completing of the famous Croton reservoir and aqueduct. It was this supply of pure water which made possible the growth of New York City a century ago. Incidentally, the original title for that book was "Dam the Waters."

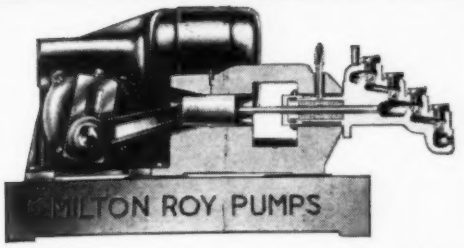
* * *

Memo to Pee Bees:—I'm in great luck—After much effort, I have been able to find a copy of that now famous (and out of print) book on "What I Know About Bridge and How I Play It," authored by Marsden C. Smith, Chief Engineer, Utilities Department, Richmond, Va.

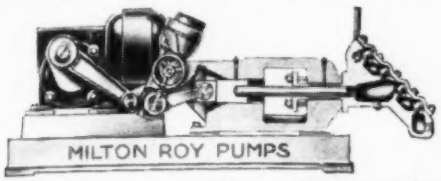
Do you think, exalted members of the Pee Bees, that owning a copy of this priceless first edition will make me eligible for membership—or do I have to read it?

* * *

Thanks to Fred Stuart, that peripatetic Baltimore salesman of many things for water works (not the least of which is activated alum or Palmer Filter Sweeps, or—but I could go on for paragraphs). — Yes, thanks to Fred I learned that out in Dayton, Ohio, the "Bewitching Mrs. Henry Jacomet" is a water witch who claims never to have failed to find water in 27 years.—



Stroke Adjustment—Screw. Liquid End—Alloy.



Stroke Adjustment—Micro while running.
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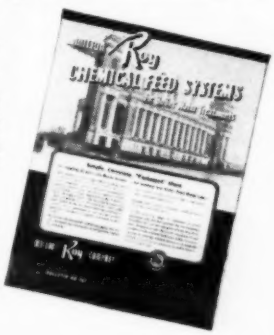
Milton Roy Pumps are widely used for treating boiler feedwater, introducing chemicals directly into boiler drums or feeding to the suction side of the boiler feed pump as may be required.

They are used also for municipal and industrial water treatment. Chemicals commonly handled in water treatment include sodium sulfite, sulfate, nitrate and phosphates; Calgon or other polyphosphates, soda ash and caustic soda, ammonium hydroxide, lime slurry and organic water treatments. Chemicals for cooling water include hypochlorites, sulfuric acid, chlorphenates and chlorbenzols.

Milton Roy Pumps have application in the sewage and industrial-waste fields, handling such chemicals as ferric chloride, ferric sulphate, sulfuric acid, caustic soda, lime slurries and hypochlorites. Positive metering of chemicals assures accurate control of treatment and avoids waste of costly materials.



Ask for Catalog 146 and Bulletin 451 "Milton Roy Chemical Feed Systems for Boiler Water Treatments."

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Use Hooker Chlorine for Effluent Sterilization

CHLORINATION of effluent is rapidly becoming standard practice in many sewage treatment plants. Not only does the chlorination of the effluent reduce the bacteria count, but tests indicate that by chlorinating sufficiently to maintain a residual of from 0.5 to 1.5 ppm a pronounced improvement was effected in the quality of the body of water into which the effluent was discharged.*

If you are planning on using chlorine in your sewage treatment, you can insure consistently uniform results by specifying Hooker Chlorine.

Because users know that they can depend on Hooker for uniform high quality, Hooker Liquid Chlorine is being specified by many sewage treatment plants and is the favorite there, as it has been among water works officials since Hooker first produced Chlorine over forty years ago.

Hooker's Technical Staff, with a background of experience that started with early commercial production of chlorine is at your service in solving your problems involving chlorine, and the other Hooker Chemicals.

"Hooker Liquid Chlorine" is a booklet which contains helpful information on this chemical and includes sections on materials for equipment, precautions, physical and chemical data and useful tables. Every water works and sewage official should have a copy. Available free when requested on your letterhead.

*"Results of Effluent Chlorination at Cleveland." Water Works and Sewerage, Aug., 1944, page 300.

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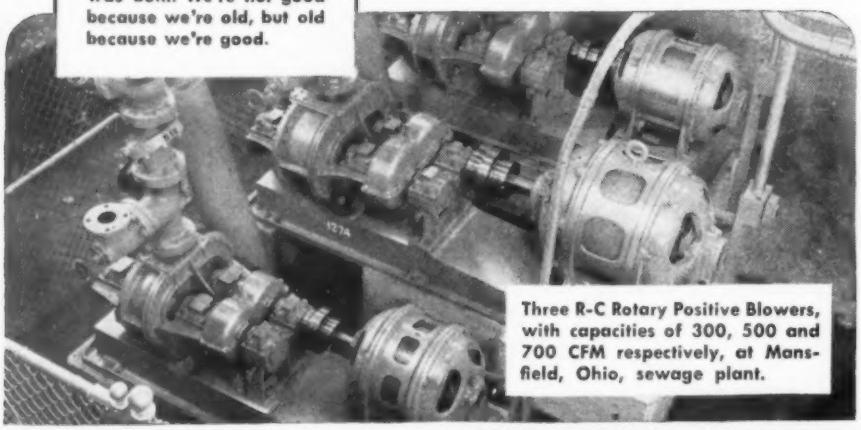
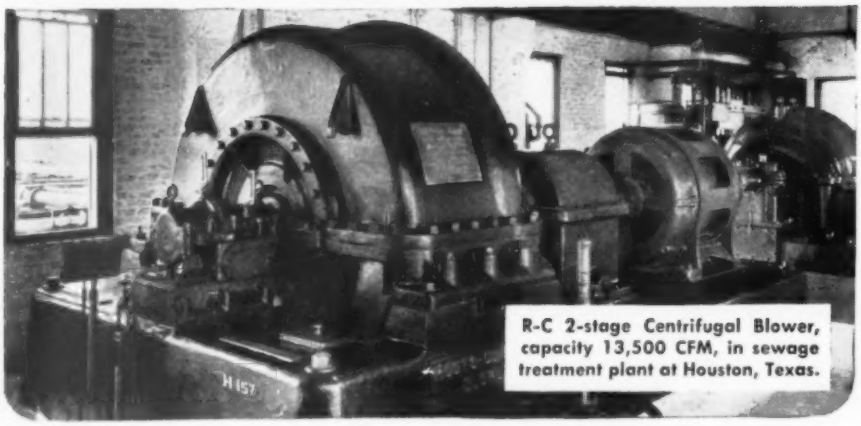
Oil was first produced by drilling in 1859, five years after the first Roots Blower was built. We're not good because we're old, but old because we're good.

NO "HEDGING" ON BLOWER QUESTIONS FROM *R-C dual-ability*



Three R-C Rotary Positive Blowers, with capacities of 300, 500 and 700 CFM respectively, at Mansfield, Ohio, sewage plant.



R-C 2-stage Centrifugal Blower, capacity 13,500 CFM, in sewage treatment plant at Houston, Texas.

When you ask Roots-Connersville engineers about blowers or gas pumps for sewage plant or waterworks applications, you'll get unbiased answers, without "hedging" between Centrifugal or Rotary Positive equipment.

That's because of our *dual-ability* to design and build both types. We recommend whichever is best suited to the specific application. We are the only blower builders offering you this important *dual choice* . . . an advantage which usually saves time, money and trouble.

Our long experience in supplying sewage plant and waterworks equipment, including meters and vacuum pumps as well as blowers and gas pumps, results in reliable and economical performance of R-C units.

For straight answers that mean long-time satisfaction, consult R-C *dual-ability*.

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* * ONE OF THE DRESSER INDUSTRIES * *

Fred read her story in the *Dayton Daily News*, which gave the pros and cons of dowsing.—The U.S. Department of Interior has a booklet called, "The Divining Rod, a History of Water Witching"—. In case you're interested.

* * *

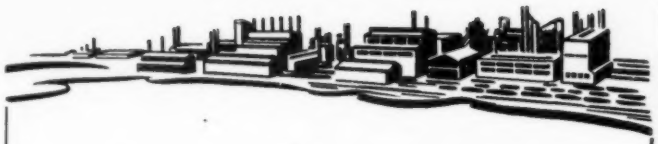
And so it goes—sometimes!!! Last June Aubrey B. Sleath, Cons. Engr. of Niantic, Conn., asked me for a couple of ideas to work into a talk he was to give on sewage treatment to a Chamber of Commerce group in a village in need of sewage treatment. Sleath thought it was an excellent idea to start off the project with good public relations and I agreed. So he developed his talk around some of the public relations aspects of the problem.—What happened to Aubrey B. Sleath shouldn't happen to a speaker—but does. But, here, read his own account of the affair:

"Dear Doc Symons: This concerns my first attempt to get "Public Relations" off on the right track at the beginning, and may I be pushed, face first, in a sludge bed if I am not telling the whole truth about what happened.

The president of the chamber of commerce of this little town of 3,000 potential customers for water and sewage service invited me to talk before the chamber, and it seemed a good place to start public relations. The moment I said yes, expecting the usual steak supper meeting, the high school was hired and the public invited. This meant an address instead of a talk—and no steak supper, and this is where I called on you for help. Thanks very much.

After your phone call on the 24th June, I worked your ideas and some of Mr. A. H. Ullrich's ideas into the address and, just as it was finished, Chairman Martin adjourned the Republicans until 7:30 p.m., half an hour before my talk was scheduled. Obviously, there would be no Republicans in my audience. It looked bad, and then the rain came and it looked worse, and we arrived in town in a terrific thunder storm. This is the truth, and may I be pushed face first in a sludge bed, etc. but there was no place to park; the high school playground was full of cars, the streets about were lined with 'em and folks, God bless them, were going in the school in the rain and everything. We finally found a place behind a telephone pole, half way down a bank, and parked the car and dashed to the school to really give out for public relations.

Inside, a girl was selling tickets, but she did not know where the presi-



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INDUSTRIAL WASTE CONTROL

being handled adequately?

If so . . . you know

The quantity of your waste.
The quality of your waste.
How sampling has been conducted.
The field survey determined exact location of sewers and outlets.
You can secure a complete set of drawings and specifications for a plant acceptable to meet municipal, state or federal requirements.

If not . . .

THE ENGINEERING DIVISION OF Pittsburgh Pipe Cleaner Company,

Under the technical direction of one of the foremost industrial waste water authorities, will act as your consultant on these problems. There is only one way to insure adequate waste control, by following a step by step program. Any omission of any step can result in more than doubling the cost of treatment and often in the building of a plant that will not meet requirements.

Write for detailed folder explaining this step by step program

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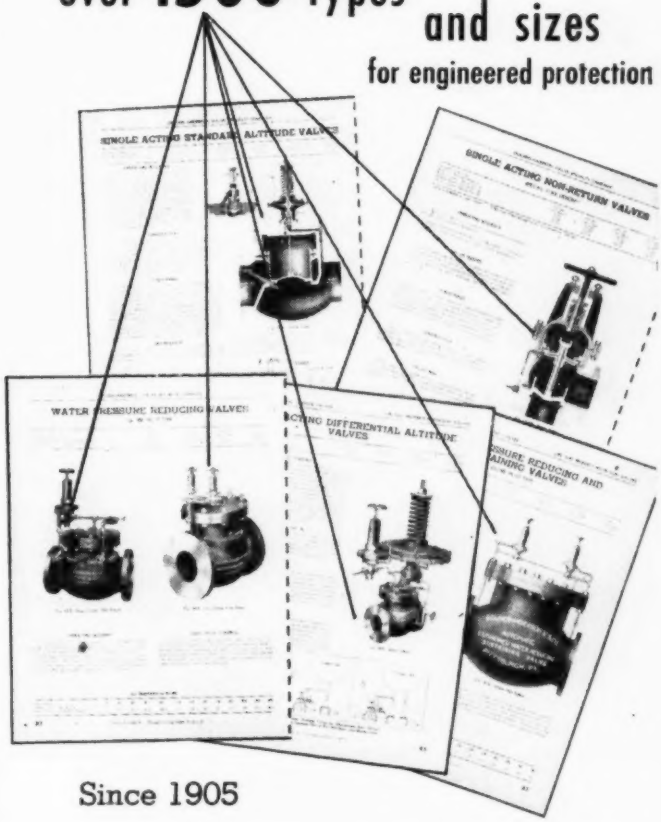
over 1500 types and sizes
for engineered protection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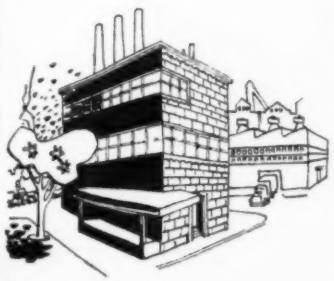


For more than 35 years Valves by Golden-Anderson have proven satisfactory in the protection of life and property. Engineer-designed to give safe, dependable control under even the most difficult and adverse conditions. For complete informative and technical data, send our engineering department your most difficult assignment.

GOLDEN-ANDERSON
GA *VALVE* **Specialty Company**
Keenan Building • Pittsburgh 22, Pa.

dent of the chamber of commerce was, the tickets were for an exhibition dance by high school girls, and so were the cars—and the people. Woe was I.

Down in the cellar, I found a lighted room and there was one guy in it. He said, "I am the president of the Chamber of Commerce." That's all. There was nothing more to say. Later, seven men came in and I shook each of their hands twice. Two of the men came in to get out of the rain—but no matter—and I gave the address.

That evening, if all those dancing girls were lined up in front of a fresh wet sludge bed, I would not have hesitated. Would you? Sincerely, Aubrey B. Sleath, Public Relations Engineer?"

* * *

Richard Bennett, Hydraulic Engineer, Phoenix, Ariz., sent me a nickname for my collection. A close friend of Bennett's is called "Sliver" because, as a baby his father's friends said he looked like a chip off the old block, or a "Sliver"—The name stuck.

* * *

GUESS WHOSE!!!!

I show you here the hands of a famous reader of this magazine. Two bucks to the first one to identify them.

* * *

Perhaps some of my readers will be as shocked as I was to learn of the recent death of Mrs. Richard Wagner of the Zeolite Chemical Co. Dick passed away suddenly last spring—and now "Babe" is gone.—"

* * *

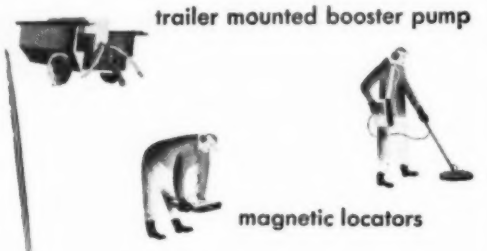
I see where "Jo" Quinn (formerly Acting Chief Sanitary Engineer, Ind. Dept. of Health, and V.P. of the Indianapolis Speedway) is one of the commissioners of the new Ohio River Sanitation District.

Y'know, I'm glad that "Jo" has kept his hand in water and waste treatment. He makes such good copy. I still remember talking to "Jo" about some of the speeches he had delivered throughout Indiana selling stream pollution abatement.

On one occasion "Jo" appeared in the pulpit of a church and believe it or not had complete control over his usually colorful language. On another occasion, "Jo" was in the middle of his arguments before a ladies society, when the presiding lady interrupted and asked if he would mind while their scheduled musical program went on. Seems the long-haired musicians (a piano and fiddle) had to catch a train. So "Jo" stepped aside while the ladies listened to Mendelssohn's Spring Song and Narcissus for an encore. And then our Mr. Quinn went on as though nothing had happened.

But the best was when "Jo" took part in a memorial ceremony for the "dear departed sisters" before he was permitted to step before the group with his story of the importance of saving streams of Indiana from pollution. Those of you who know Joseph L. Quinn, Jr., who is a fast boy with the words, can imagine him with head bowed while soft music wafted through the room mixed with the scent of rose petals strewn before an altar, and dedicatory words were whispered by an elocution teacher.

all this and radio too,

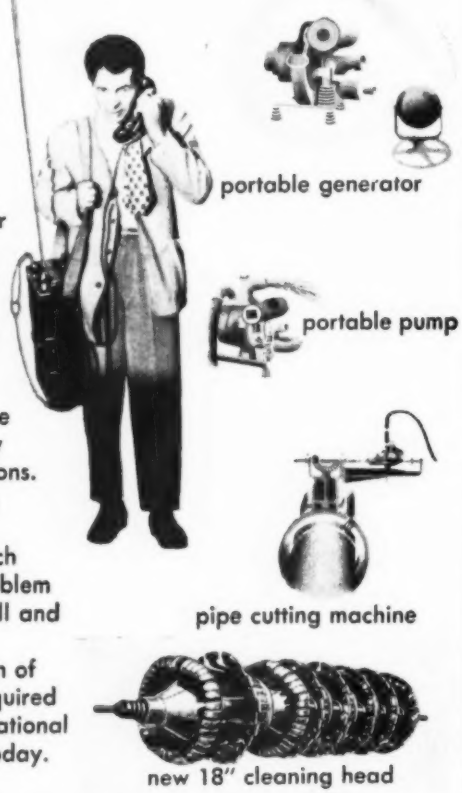


helps NATIONAL clean water mains faster, better and more economically

The highly specialized equipment employed by the National Water Main Cleaning Co. today includes: walkie-talkie radio systems for maintaining constant communication between the point of operation and control valves or pumping stations, magnetic locators for tracing underground pipe, truck-mounted pumps for dewatering, trailer-mounted booster pumps for stepping-up pressure, pipe cutting machines and a tremendous variety of cleaning heads developed to meet the requirements of varying pipe sizes, conditions and layouts.

Even more important than adequate equipment is the experience necessary to cope with all conditions and situations. The nature of the obstruction, varying pipe sizes, unusual pipe layouts, the character of the water — all make each cleaning assignment an individual problem calling for specialized experience, skill and equipment.

We'll be glad to check the condition of your water mains, recommend the required treatment and estimate the cost of National Water Main Cleaning service. Write today.

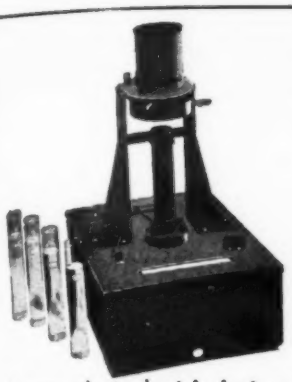


NATIONAL WATER MAIN CLEANING COMPANY

50 Church Street, New York 7, N. Y.

28

ATLANTA, 1221 Mortgage Guarantee Building • BOSTON, 115 Peterboro Street • CHICAGO, Room 1336, 122 So. Michigan Avenue • HOUSTON, 2518 Grant Street • KANSAS CITY, 421 BMA Building LOS ANGELES, 448 South Hill Street • MEMPHIS, 822 Dermon Building • OMAHA, 3812 Castellar Street • RICHMOND, 210 East Franklin Street • SPRINGFIELD, MO., 844 North Main Street • SALT LAKE CITY, 149-151 W. Second So. Street • SAN FRANCISCO, 681 Market Street • MONTREAL, 2028 Union Ave. • VANCOUVER, B. C., 505 West 1st Ave. • WACO, P. O. Box 887 • WINNIPEG, 576 Wall Street • HAVANA • MAYAGUEZ, PUERTO RICO • BOGOTA • CARACAS • MEXICO CITY



LUMETRON

Photoelectric Colorimeter Model 450 for Nessler Tubes

A new photoelectric instrument of high accuracy for the measurement of color and turbidity, as well as for all analytical colorimetric tests in the examination of water and sewage.

- Turbidity tests in terms of APHA (ppm) scale.
- Color tests in terms of APHA (mg Pt) scale.
- Suited for determination of ammonia nitrogen, nitrate, nitrite, and for all other colorimetric tests according to APHA "Standard Methods."
- Operates with all "low form" Nessler tubes 32 mm O.D., 200 mm high. Requires no matched sets or tubes.

LUMETRON Mod. 450 eliminates the uncertainties of visual matching methods. It requires no permanent color standards and furnishes reproducible results independent of individual judgment and of light conditions.

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PHOTOVOLT CORP.

95 Madison Ave. New York 16, N. Y.

Write also for literature on

PHOTOVOLT Line-Operated pH METER

5 GOOD REASONS

for buying Blaw-Knox Grating . . . COUNT 'EM!

1. STRONG electroforged construction for easy erection.
2. MAXIMUM OPEN AREA for light and air.
3. EASY TO MAINTAIN . . . paint reaches entire surface.
4. SELF-CLEANING, no sharp corners to clog.
5. SAFE footing at all times with twisted cross bar.

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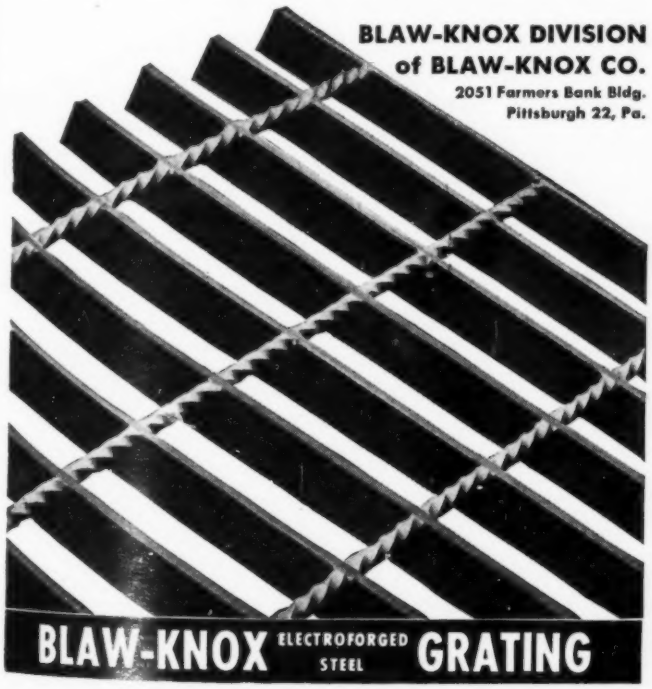
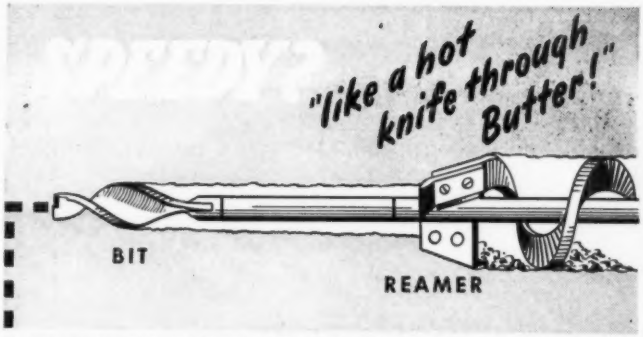


BLAW-KNOX ELECTROFORGED STEEL **GRATING**

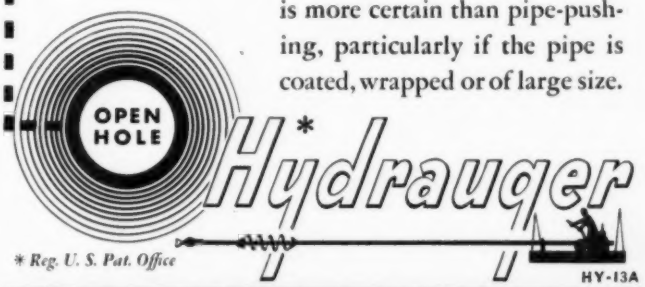


THE LOW COST WAY TO INSTALL ANY PIPE

Write for Catalog No. 8 TODAY!

HYDRAUGER CORP., Ltd.
681 Market Street
San Francisco 5, California

Even the toughest earth formations, like rotten rock, are no obstacle to Hydrauger operations. In fact, Hydrauger has fewer limitations, especially in time and costs, than trenching; and it is more certain than pipe-pushing, particularly if the pipe is coated, wrapped or of large size.



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EARTH BORING TOOL

—FOR SALE—

BELL and SPIGOT CAST IRON PIPE

used EXCELLENT CONDITION

(all 12 ft. lengths)

CLASS C—AWWA		CLASS D—AWWA	
500 ft.—	8" diam.	350 ft.—	4" diam.
5500 "	—10" "	19,200 "	— 6" "
4200 "	—12" "	29,000 "	— 8" "
10700 "	—16" "	1,180 "	—10" "
1800 "	—18" "	1,400 "	—12" "
1080 "	—20" "		
680 "	—24" "		

Some pipe is cement lined, some is enamel lined and some is unlined.

Prompt shipment in carload quantities only.

Subject to prior sale.

L. B. FOSTER CO.

(address office nearest you)

New York 7 Pittsburgh 30 Chicago 4 Houston 2 San Francisco 4

It didn't phase Jo, though; he came right up with a tie-in between the service of those dear departed sisters and the service the living owed to their posterity, etc. etc. etc. Jo's pet project now, among many, many others, is the annual Indianapolis Speedway 500-mile Classic. That moves a little faster than a lazy Indiana stream.

* * *

I wish I knew where I got this story about Bernard Keany, a meter reader of Dedham, Mass.—Mr. Keany believed in doing good deeds while on his route. One day he saw a man struggling to load part of a furnace on a small truck. So he helped the fellow. The man thanked Mr. Keany and drove away.

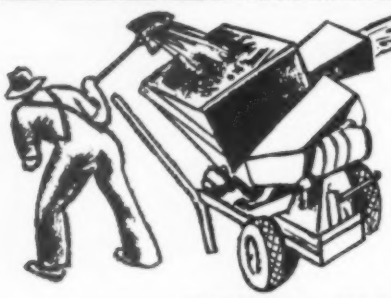
It wasn't until late that afternoon when Keany was called to the police station that he learned he had been a party to the theft of the furnace. The furnace had been delivered to the house and left on the grass pending the arrival of the plumber. But before the plumber arrived a man with a truck and larceny in his heart saw the furnace and proceeded to appropriate same—with Bernard Keany's help—of course.

I suppose you've all heard my new theme song, "You Call Everybody Darling"—Happy Thanksgiving To You—And that'll be all for a spell.—V.T.Y. Doc.

THE SPILLWAY

[Overflow from the main section]

Royer Sludge Disintegrator NSB-4 (3-6 yds. per hour capacity) processing sewage sludge at Charlotte, N. C. plant.



As easy as it looks with a

ROYER SLUDGE DISINTEGRATOR

Turning out cash dollars is far from being a "pipe dream" with a Royer Sludge Disintegrator. Hundreds of sewage treatment plants are doing it . . . taking their waste sewage sludge (that so many plants burn or bury at their own expense) . . . shoveling it into a Royer, along with various chemical concentrates . . . bagging it, for sale as commercial fertilizer. No trouble at all. The Royer easily handles sludges with up to 56% moisture . . . at production speeds from 1 to 12 yards per hour, depending on the model. Why not put *your* sludge in the profit column with a Royer? Write for a copy of our "Sewage Sludge Datalog."

ROYER

PIONEERS IN THE SALVAGE OF SEWAGE SLUDGE

ROYER FOUNDRY & MACHINE CO.

170 PRINGLE ST., KINGSTON, PA.

M. P. Crabill Appointed Supt. of Purif., Indianapolis Water Co.

Succeeds the Late C. K. Calvert

Marshall P. Crabill has been named Superintendent of Purification of the Indianapolis Water Co., succeeding to the vacancy left by the death of the

late C. K. Calvert. Mr. Crabill has been Acting Superintendent since Mr. Calvert's death. He is a graduate of Purdue University, and has been employed by the water company since 1933. He was successively Engineering Assistant, Plant Engineer, and Assistant Superintendent.

Mr. Crabill is Vice-Chairman of the Indiana Section of the A.W.W.A. and is a member of the American Society of Civil Engineers, and other professional and civic organizations.

Nash, Cadmus & Voelker Consulting Engineers

The new firm of Nash, Cadmus & Voelker Inc., 45 W. 45th Street, New York 19, N.Y., is offering to consulting engineers service on the design and erection of incinerators for the disposal of wastes. All phases of waste disposal by incineration are included within the scope of the organization.

Members of the firm are George A. Nash, former Manager of General

Sales, Morse-Boulger Destructor Co., Thomas W. Cadmus, former General Manager Kerner Incinerator Co., General Construction Manager and Asst. Vice President of Morse-Boulger Destructor Co., and Edward M. Voelker, former Chief Engineer of the Morse-Boulger Destructor Co.

Annual Reports of Interest

The following brief abstracts have been made of annual reports received within recent months. Copies of the reports may be obtained by writing to the superintendent of the department or plant in question.

WATER SUPPLY

Louisville, Ky.; 1947. (96 pages.) B. E. Payne, Chief Engr. and Supt. Number of consumers increased 2,280 during the year, bringing the total to 81,066 active services. Total revenue from the sale of water was nearly $3,000,000; net income $1,303,575. Average pumpage 62.2 mgd. Cathodic protection is used on elevated tanks. 87 breaks on the smaller mains. The department entered into an agreement with the Louisville Sanitary District to add a sewer service charge to the water bill. Water company employees are unionized. Accumulation of net income is used to defray the cost of construction without resorting to borrowed money.

North Jersey District Water Commission. 1946 and 1947. (36 pages.) Charles H. Capen, Jr., Chief Engr. The North Jersey District Water Commission obtains its water from the Wanaque Reservoir. Daily pumpage, 17.2 mgd. Laboratory control consists of sampling analyses at five locations. Analytical tests include bacteriological, chemical, and microscopical observations. Chlorine treatment uses 1.0 ppm. at the head waters. Lime treatment is used to minimize corrosion and prevent red water complaints. Average lime dosage is 40.7 lb. per mil. gal. Ammonia and copper sulfate are both used for taste and odor control, the latter to kill algae in the reservoir.

Orlando, Fla.; 1947. (48 pages.) Twenty-fifth Anniversary Report of the Orlando Utilities Commission, reviewing the history of the commission from its early beginning. A story of the electric light plant as well as the

Alhydro FLOC PRODUCER

...REDUCES CHEMICAL STORAGE PROBLEMS IN INDUSTRIAL OR MUNICIPAL WATER TREATMENT PLANTS

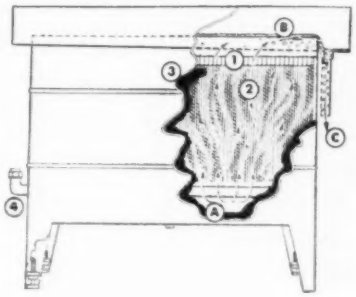
"Right!

69 lbs. of aluminum treats as much water as nearly 3/4 ton of coagulants"

By employing the principle of low voltage, DC, electrolytic dissolution of aluminum plates in water, the Alhydro Floc Producer greatly reduces the necessity for protecting and storing bulky chemicals. In addition, the Alhydro Floc Producer easily provides the simplest and most foolproof answer to the problem of removing color and suspended matter from process or drinking water. It produces a readily controllable concentration of remarkably stable floc . . . even under water conditions so adverse that floc formation would be impossible with older methods.

One Alhydro Floc Producer will treat an average of 300,000 gallons of water per day . . . but the units can be used singly or in multiples in present or proposed water treatment plants.

SKILLFUL ENGINEERING OF THE ALHYDRO FLOC PRODUCER
gives simplicity of operation . . . ease of maintenance

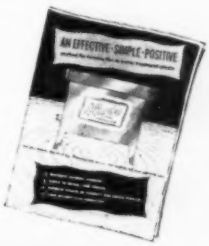


1. Connector Bar on each side of tank
2. Alternate Stainless Steel and Aluminum Plates.
3. Composition rubber lined stainless steel tank
4. Water Feed Line easily removed for inspection

A. Water enters tank through slots in feed pipe.
B. Concentrated floc is carried to the top and leaves through discharge trough.
C. Discharge pipe feeds floc to raw water.

DESCRIPTIVE FOLDER--FREE!

Read this folder which illustrates and describes the advantages of the compact Alhydro Floc Producer. See how you can simplify the treatment of drinking water or water for industrial use. Write for your free copy today.



ALHYDRO, INC. DEPARTMENT 11B 516 N. CHARLES ST., BALTIMORE 1, MD.

water service is included. A new power and water plant is under construction.

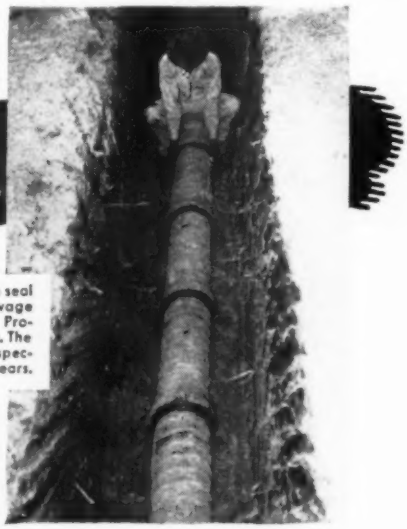
Portsmouth, Va.; 1947. (22 pages.) X. D. Murden, Supt. Three new pumps were installed and a 10-in. subaqueous main was installed in a suburb. Cranes and other equipment installed for handling ton containers of chlorine has reduced the cost of this chemical by 60 per cent; 90,000 pine seedlings were planted on the water shed. Water pumpage average 10.0 mgd. One distribution system showed an increase of 11 per cent while the other was practically the same as the year before.

SEWAGE TREATMENT

New Britain, Conn. Fiscal year 1947 and 48. (24 pages mimeographed.) John R. Szymanski, Supt. Average flow 11.78 mgd.; grit removed 220 cu. yd.; grease skimmings removed 28.6 tons wet basis per month. Chemical treatment 329,430 lb. of ferrous sulfate and 92,000 lb. of chlorine to make chlorinated copperas plus 123,800 lb. of Ferrisul. Activated sludge treatment 0.12 cu. ft. of air per gal. of sewage. Sludge de-watered with ferric chloride and wet prestolime; filter yields 5.32 lb. per sq. ft. per hour. Sludge incinerator, 4,852,636 lb. burned; 58,182 gal. of oil used; ash removed 48,669 cu. ft. Raw sewage suspended solids 217 ppm., final eff. 39 ppm.; B.O.D. raw sewage 184 ppm., final eff. 48 ppm.

KALKTITE

COLD APPLIED SEWER JOINT SEALER



Kalktite being used to seal pipe joints on the Sewage Disposal Expansion Program, Greenville, Miss. The City of Greenville has specified Kalktite for years.

Sets Up Internally Even Under Water

. . . Resists Roots and Acids

Wet trenches do not delay the job when you use Kalktite, cold applied Sewer Joint Sealer. It sets up under water, will not wash away or remain soft. It sets to a hard, tough body that is flexible and permits settlement of pipe in the trench without breaking the joint.

Kalktite contains an ingredient that is poisonous to vegetation and tree roots. It is not affected by sewer acids and gases or alkali. Mixed right on the job, Kalktite is easy to use and handle.

Write for sample and complete specifications.

PRESSTITE Sealing Compounds

PRESSTITE ENGINEERING COMPANY

PEC-177 3918 Chouteau Ave. • St. Louis, Mo.

J. H. LeVan Replaces Lamoureux in U.S.P.H.S. N.Y. Office

Upon the transfer of Vincent B. Lamoureux to the National Security Resources Board in Washington, D. C., the position of District Engineer of the U. S. Public Health Service, District No. 1, New York City, has been filled by the appointment of James H. Le Van. Mr. Le Van was formerly Field Coordinator of the Vessel Sanitation Section, U. S. P. H. S.

Well Clinic

The third meeting of the Northeastern Well Clinic was held in Aurora, Ill., on Sept. 14th, at the Sky Club. This meeting, which was open to all interested persons in the water works operation, city officials, industrial, and municipal operation, was attended by representatives of the State Dept. of Health, State Geological Survey, and the State Water Survey, as well as many members of the Ill. Section A.W.W.A. and operators from eleven counties in the State.

Included in the program was a talk on "Analysis, Interpretation and Significance of Well Sampling" by T. E. Larson, Chemist, Ill. State Water Survey, and the study of "Well Spacing and Recession" by H. F. Smith. Railroad water supply problems were also discussed.

Laboratory Control Of Water Purification

"Laboratory Control of Water Purification" as authored by Charles R. Cox, Chief of the Bureau of Water Supply, Div. of Sanitation of N.Y. State Dept. of Health, is presented as "a hand book of laboratory practice in the water works plant prepared particularly for the man who has not had the advantages of extended training in chemistry and bacteriology." According to the publisher's preface, this completely revised edition has been organized to present the functional application of laboratory procedure to the control of water supplies. The material incorporated in the book originally appeared as a series of articles in *Water Works Engineering*.

The book contains 24 chapters beginning with principles of chemistry, and treating such items as aeration, microorganisms, taste and odors, mineral constituents, pH, alkalinity, carbon dioxide, turbidity, color, coagulation, residual chlorine, chlorination, hardness, softening, corrosion, bacteriology, etc.

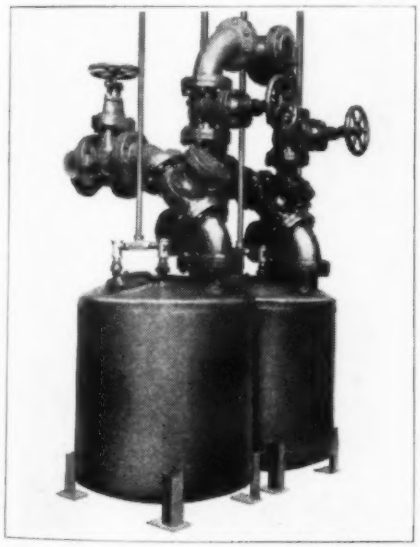
The book contains 342 pages, is published by Case, Sheppard, Mann Publishing Corporation, 24 W. 40th St., New York 18, N. Y., and retails at $4.00 a copy.

MANUFACTURERS' *and* EQUIPMENT NEWS

1100

Sewage Ejector

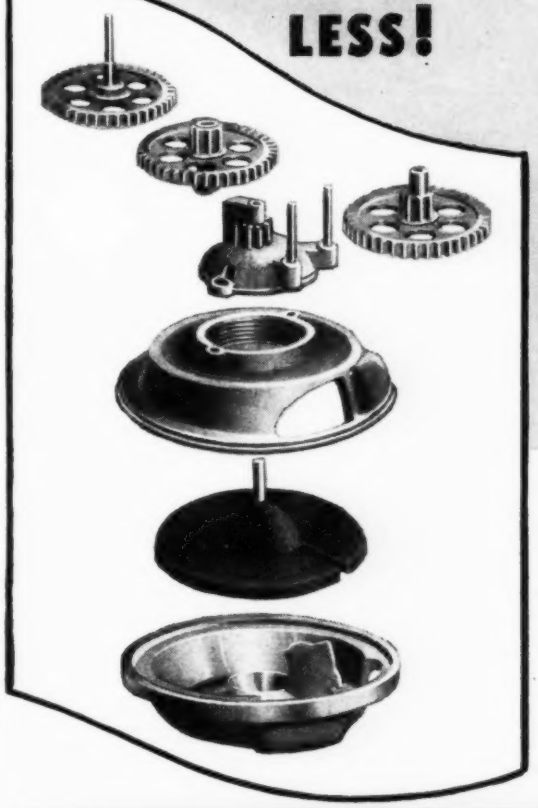
Ralph B. Carter Co., Hackensack, N.J., has developed a new sewage ejector as a solution to small capacity pumping problems. The units shown in the accompanying photograph can



take solids up to 4-in. spheres without clogging. These pneumatic ejectors, which are electrode controlled, contain no moving parts. When installed and operating there is no accumulation of solids and no accumulation of gas.

For further information on this sewage ejector, use a Reader Service Card on which is entered the above key number and your name and address.

BUFFALO METER
Simplicity
COSTS YOU LESS!



● Buffalo Meters have a more simple construction than most water meters, with fewer moving parts. Because of this, these top-quality meters can be sold at moderate price.

Maintenance costs for Buffalo Meters are low. Repair costs are reduced since Buffalo Meters can be taken apart and put together more quickly than can be done with meters of more complicated design. Also, few moving parts means less replacement... ordinarily a considerable item of expense in meter maintenance.

● Buffalo Meter Company makes two brands of water meters... the "American" (bronze casing) for soft or filtered water, and the "Niagara" (galvanized-iron casing) for most hard water requirements. Send for descriptive literature... today!

AMERICAN BRONZE CASE
NIAGARA GALV. IRON CASE
WATER METERS
BUFFALO METER COMPANY
2909 MAIN STREET • BUFFALO 14, NEW YORK

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

KNOWN AROUND THE WORLD AS THE SIGN OF EXCELLENCE IN WATER TREATMENT EQUIPMENT

The years of experience behind the Roberts nameplate is your assurance that any water rectification problem is expertly handled to your best advantage. As manufacturing and installation engineers, the Roberts organization is equipped to meet your exact needs regardless of the size of the equipment or the complexity of the problem.

GRAVITY FILTERS • SOFTENING PLANTS AND EQUIPMENT • PRESSURE FILTERS ZEOLITE SOFTENERS • SWIMMING POOL RECIRCULATING APPARATUS SPECIAL WATER TREATMENT EQUIPMENT

We invite your inquiries

ROBERTS FILTER MANUFACTURING COMPANY • *Darby, Pa.*

Neptune Acquires Rensselaer Valve Co.

Announcement has been made by the Neptune Meter Co. of its acquisition of a controlling interest in the Rensselaer Valve Co. of Troy, New York. Rensselaer Valve Co. is one of the oldest manufacturers of valves and hydrants in the United States.

John H. Ballatine, D. E. Broggi, J. R. Van Gorder, and A. A. Hanson, all directors of Neptune Meter Co., have been elected to the Rensselaer Board. E. A. Rutledge will continue as Vice President and General Manager, and Director. Sales will continue through present outlets.

G.E. Equipment For Dredging on Schuylkill River

Electric equipment for the giant operation of dredging a 75-mile stretch of the Schuylkill River between Port Clinton and Norristown, part of the Pennsylvania Legislature's 10-year program to clean up the state's waterways, will be supplied by the General Electric Co., it has been announced.

The equipment will power four dredges costing more than $1,000,000, which are being built for the project by the American Steel Dredge Co. at Fort Wayne, Ind.

The river became unnavigable several years ago because of deposits of sewage and coal silt or culm from the mines along the river.

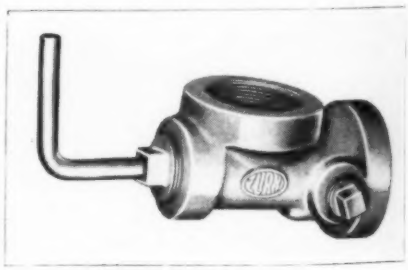
Wm. Scott Represents Hays Mfg. In South

The Hays Manufacturing Company of Erie, Pennsylvania, has appointed Wm. (Bill) Scott as Sales Representative for the Southern Territory. A native of the South, Mr. Scott is a graduate of the Georgia School of Technology. His training and experience have been in the fields of water, gas, steam, plumbing and other industries served by Hays.

1101

Grease Interceptor Flow Control Tee

J. A. Zurn Mfg. Co., Erie, Pa., has developed the Flow Control Tee designed to distribute properly the discharge from one or more fixtures through a grease interceptor. Such control guarantees foolproof operation, guards against overloading due to sudden surges, and maintains flow so it can operate at a high efficiency.



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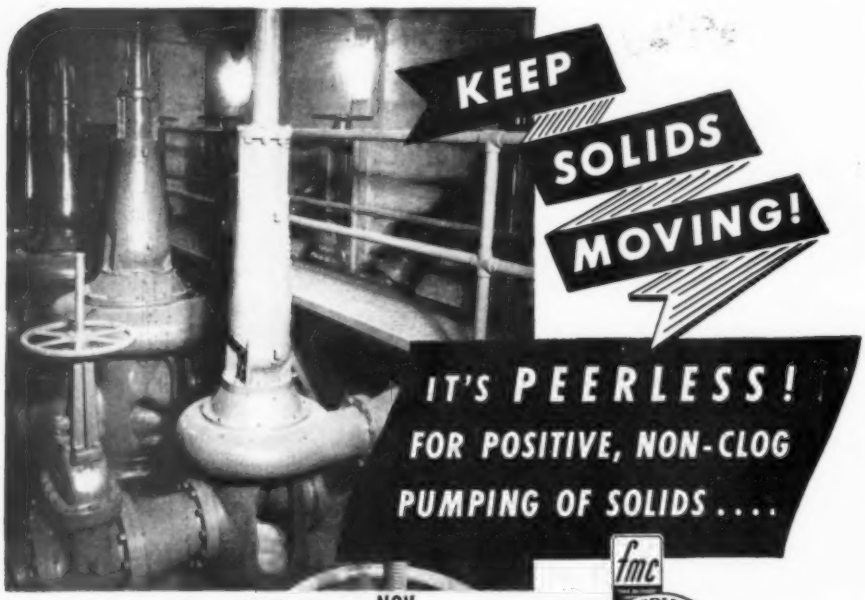


VERTICAL TYPE NCV

Horizontal & Vertical Type Non-Clog Pumps for Dry Basin Installation

CAPACITIES: *Up to 7000 GPM* HEADS: *Up to 70 ft.*

Non-Clogging in Action as well as in Name Through Peerless' Exclusive Impeller Design

The heart of this pump is the impeller. The two-port Peerless impeller, shown at right, has unique repelling vanes on both the outer shrouds, and scientifically designed working vanes of uniform thickness to keep solids moving. Peerless Non-Clog Sewage Pumps offer a modern and dependable means of pumping entrained solids in sewage disposal service, paper mills, canneries and packing plants, process industries, and for lift stations, railroad underpass applications, etc.

No rings to clog–no seals to bind! Unique repelling vanes on both outer shrouds keep solids clear at casing side walls.

TYPE NCH... HORIZONTAL NON-CLOG TYPE

By eliminating all wearing rings, end plates, filler rings, etc. and minimizing recirculation losses, the advanced design principle of the Peerless Sewage Pump is the ideal choice for maximum clog-free pumping service with down time at a minimum.

Request your copy of the new Non-Clog Sewage Pump Bulletin No. B-154 and compare the many Peerless advantages and improvements.

PEERLESS PUMP DIVISION

FOOD MACHINERY AND CHEMICAL CORPORATION

FACTORIES: LOS ANGELES 31, CALIFORNIA; INDIANAPOLIS, IND.

District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 No. Broadway; Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Fresno, California; Los Angeles 31, California

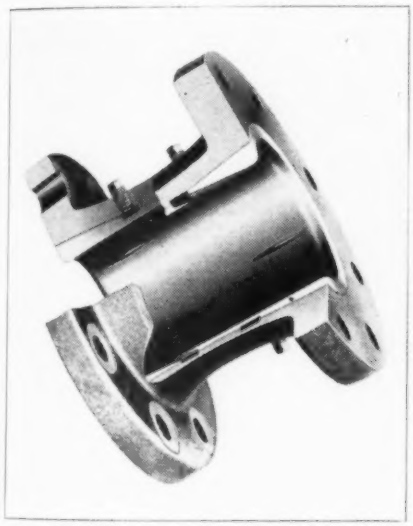
Chemical Pump & Equipment Corp. Represents Union Iron Works

The Chemical Pump & Equip. Corp., 75 West Street, New York 6, N.Y., has been appointed to represent the Process Equipment Department of Union Iron Works, Erie, Pa. The territory to be covered is all of New York east of Rochester and western Connecticut. Union Iron Works manufactures heat exchangers, and other chemical processing equipment. The Chemical Pump & Equipment Corp. also represents the Milton Roy Co., of Philadelphia.

1102

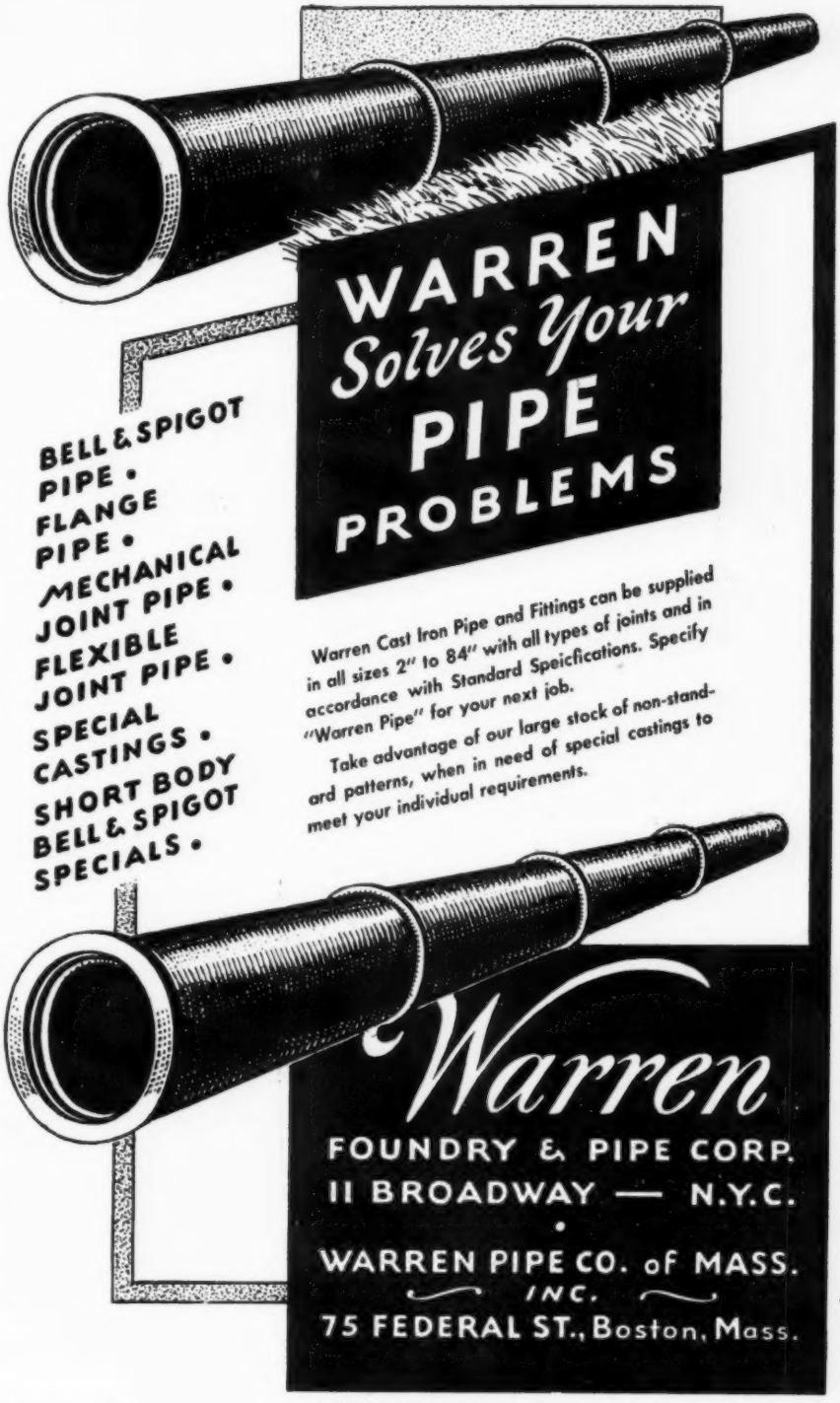
Bethlehem Flow Tube

The Bethlehem Foundry & Machine Co., Bethlehem, Pa., has developed a new device for measuring liquid flow. This device known as the Beth-Flo Gentilly Tube, is based on the theories



of Vincent Gentile, Jr. The device eliminates straight run of pipe prior to measurement. Essentially it consists of a short length of pipe equipped with two groups of pressure nozzles around the inner periphery — one group pointing upstream, the other group pointing downstream. The flow tube is normally less than one-pipe diameter in length. It is possible to install the unit in any section of pipe line with no limitations as to straight run. Flow resistance is low. Many advantages are claimed for the unit including the fact that it can be used to measure light gases as well as slow moving liquids.

For further information on this item, use a Reader Service Card on which is entered the above key number and your name and address.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Warren Cast Iron Pipe and Fittings can be supplied in all sizes 2" to 84" with all types of joints and in accordance with Standard Speicfications. Specify "Warren Pipe" for your next job.
Take advantage of our large stock of non-standard patterns, when in need of special castings to meet your individual requirements.
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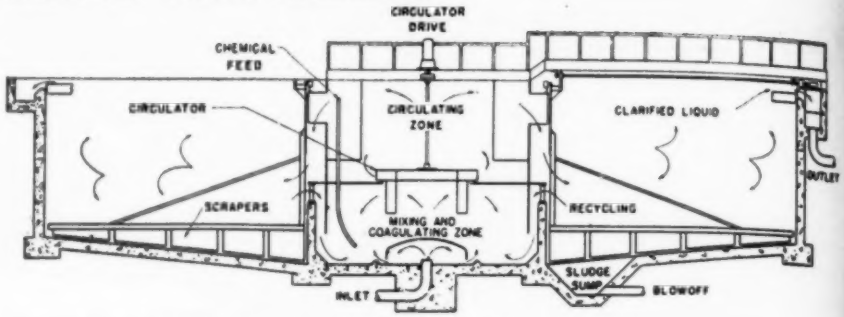
1103

Industrial Waste Treatment

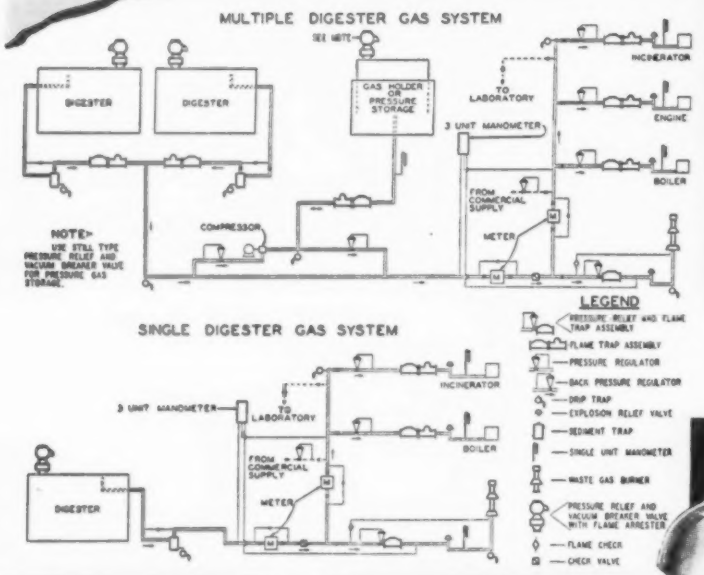


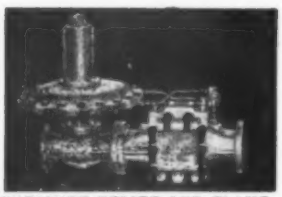
Infilco Inc., Chicago, Ill., has developed a new apparatus, known as the "Cyclator," for the treatment of industrial wastes. Essentially a development of the up-flow type clarifier, this unit is designed to handle such industrial wastes as paper and pulp, insoluble oil emulsions, etc. The unit contains a mixing zone where waste and chemicals are added in the presence of previously precipitated solids. Here coagulation in the presence of the thick slurry takes place. Solids flowing up and into the clarifier liquid section are allowed to settle by virtue of reduced velocity. The precipitated solids are drawn to the outer area of the basin, where they are thickened by rotating scrapers. A portion of these settled solids is returned to the mixing and coagulating zone and the excess blown off or pumped off from the sludge sump. Several installations of this unit in industries have already been made.

For further information on this item use a Reader Service Card on which is entered the above key number and your name and address.

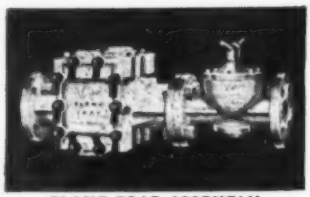
LET "VAREC" APPROVED SEWAGE GAS CONTROL SYSTEMS MINIMIZE YOUR FIRE HAZARDS

WASTE GAS BURNER

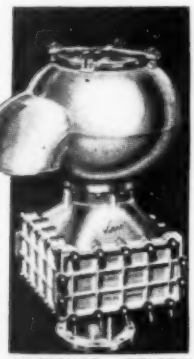




PRESSURE RELIEF AND FLAME TRAP



FLAME TRAP ASSEMBLY



PRESSURE RELIEF VACUUM BREAKER VALVE WITH FLAME ARRESTER

Wherever corrosive, toxic, or combustible gas is present, "VAREC" Gas Control and Safety Devices serve and protect with unfailing efficiency. Write for full details of a complete "VAREC" installation. . . . Ask for Catalog S-3.

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Available from Authorized Sewage Equipment Agents throughout U. S. and Canada
Cable: VAREC COMPTON (all codes)

Russell Named Secretary, Technical Chief Of Hardinge Co.

The Hardinge Co., Inc., has announced the election of Robert J. Russell as secretary of the company. Mr. Russell began work at Hardinge Company in 1929 as a service engineer, and was also appointed chief of the technical staff of the Hardinge organization.

Pittsburgh Pipe Cleaner Co. Expands Services

The Pittsburgh Pipe Cleaner Co., 133 Dahlem Street, Pittsburgh 6, Pa., has announced that its Engineering Division is expanding its services. The Engineering Division of the company is prepared now to act as a consultant to industries and perform the following services: make a complete survey, design plants and provide specifications, erect the plant and turn it over as an operating unit.

In addition the Engineering Division of the Company will make hy-

(Continued on page 101A)

READER SERVICE CARDS for

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Information — Literature

JUST CLIP THESE CARDS MARK AND MAIL — TO RECEIVE THE LATEST INFORMATION OR LITERATURE DESCRIBED IN THIS ISSUE

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WATER & SEWAGE WORKS READER SERVICE

READER SERVICE CARDS HOW TO USE THEM

Please fill out a separate coupon for each item on which you desire information. This will greatly facilitate handling.

Key number is at head of each new product, item of equipment, catalog or bulletin, described in this issue.

Enter key number in box.

Please PRINT your name and title, company or department name, and your address

NOTE—

These cards are to be used only for items described in THIS ISSUE

WATER & SEWAGE WORKS

Will see that you receive information desired.

draulic analyses of water systems, including waste water and pitometer survey, will make sewer analyses including mapping, location, and interior examination of structures, and will recondition water mains by the Pittsburgh-Eric Process.

Dreier Heads Walker Process Service Dept.

Douglas E. Dreier has been appointed to take charge of the engineering service department of Walker Process Equipment Inc., of Aurora, Ill. A graduate of the University of Colorado in 1940, and with the Master

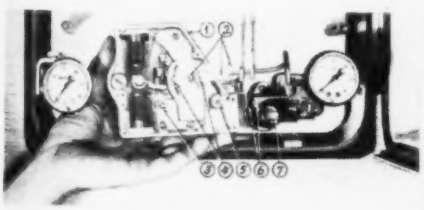
of Science degree in Sanitary Engineering from the University of Ill. in 1942, Mr. Dreier spent three years with the Ill. State Dept. of Health before joining Walker Process Equipment Inc. in Dec. 1945 as one of its organizers.

In his new capacity Mr. Dreier will handle all applications for engineering propositions, estimates, and bids for the company. He also serves as assistant secretary of the company.

1104

Pneumatic Control

Fischer & Porter Co., Hatboro, Pa., has developed a totally new Pneumatic Control Mechanism for incorporation into all Fischer & Porter flow controlling instruments.



The entire assembly may be removed from the control instrument for cleaning or repair without disturbing the process.

If you desire further information on this new control mechanism enter your name and address and the above key number on a Reader Service Card and mail to this magazine.

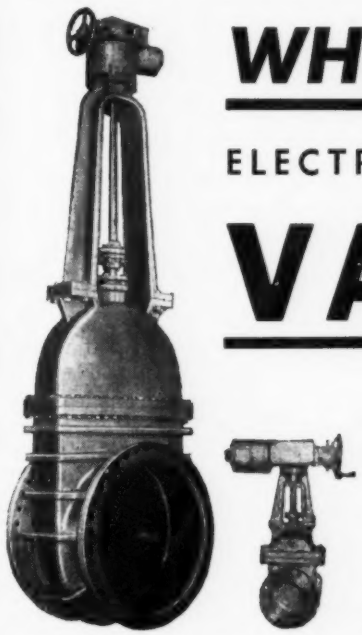
101A

AVOID COSTLY MISTAKES

WHEN BUYING

ELECTRICALLY OPERATED

VALVES



The way to avoid costly mistakes in buying motor operated valves is simple . . . make sure that your supplier has had ample experience in this highly specialized field.

Rensselaer Valve Company has had many, many years of experience in supplying such valves for use under a wide variety of service conditions.

Consult our factory-trained representatives or write direct.

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MEMPHIS, TENN. 822 Dermon Bldg.
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OKLAHOMA CITY, OKLA. 817 Braniff Bldg.
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STEAM AND WATER TYPES

FOR DIGESTER HEATING

American Radiator & Standard Sanitary Corporation, Pittsburgh, Pa.

SALES OFFICES IN PRINCIPAL CITIES

FOR RATINGS AND DATA SEE OUR PAGE IN THE ANNUAL REFERENCE SECTION

AMERICAN-Standard
First in Heating and Plumbing

1105

Activated Silica Patent

The Philadelphia Quartz Co. has announced the issuance of a process patent on the purification of raw water. U. S. Patent 2,444,774 was granted recently to Harold R. Hay and assigned to the company.

This patent covers Phila. Quartz Company's N-Sol-A Process of preparing activated silica sol which has been formed by reaction with ammonium sulfate or other salts of ammonia and dilute sodium silicate. This sol used in conjunction with a coagulant such as alum or iron salts produces rapid formation of a large floc resulting in the removal of a large percentage of impurities from the raw water.

For further information, use a Reader Service Card on which is entered the above key number and your name and address.

J. B. Cook, Jr. Joins Thornburg Co.

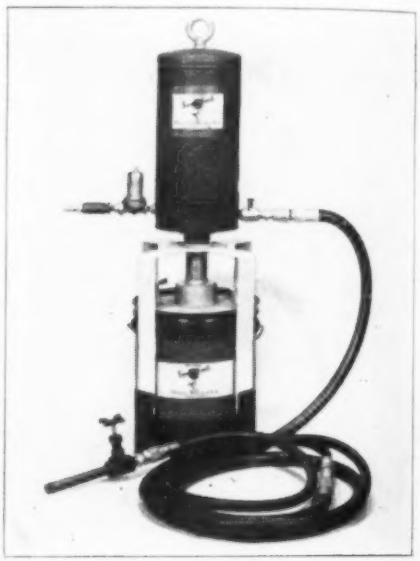
The C. I. Thornburg Co., Inc., distributors of water works and industrial supplies, has announced the association of James B. Cook, Jr. as Sales Engineer.

Mr. Cook was formerly assistant to the vice president of %Proportioneers%, and with the Thornburg Co. will specialize in this equipment and that of the associated companies, Builders-Providence and Omega Machine Co. The C. I. Thornburg Co., Inc. is located at Huntington, W. Va.

1106

Sewer Seal

Products Research Co., 1019 S. La-Brea Ave., Los Angeles 35, Calif., has developed a new sewer sealant called Pro-Re-Co Sewer-Seal. This pigmented phenylated butadiene polymer solution is a one part air-drying compound supplied in a heavy extrusion gun consistency, developed for sealing



the joints of vitrified clay tile liner plates which form the interior surfaces of large concrete sewers.

Sewer-Seal has resilience and flexibility, but is non-flowing, has perfect adhesion and may be applied cold. It has long life and is resistant to chemicals as well as to the sulfur bacteria.

For further information, use a Reader Service Card on which is entered the above key number, and your name and address.

Activated Alum Corp. Changes Name

The Activated Alum Corp. has changed its name and will henceforth be known as the Activated Alum Sales Corp. In so doing the company has expanded its sales organization for more complete representation in the water works field. The company will remain at its offices at 516 N. Charles Street, Baltimore 1, Md.

"FLEXIBLE"

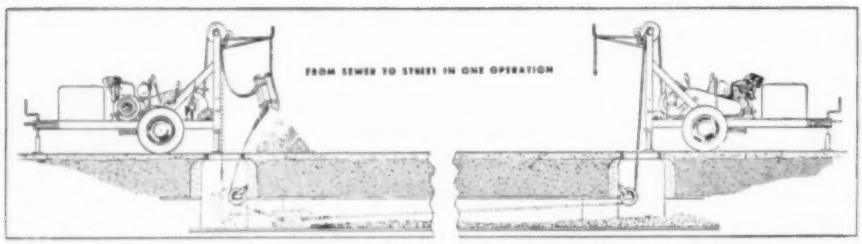
POWER BUCKET MACHINES

Clean Sewers The "Flexible" Way

Many sewer systems were heavily overloaded and neglected during war years. Now is the time to get these sluggish lines in first class condition—and "Flexible" equipment provides the means at a fraction of the cost of old style methods. Every day, more sewer cleaning jobs are being done the "Flexible" way at savings up to 80%.

POWER — DEPENDABLE OPERATION — SPEED — SAFETY — ECONOMY — LONG WORK LIFE

FLEXIBLE POWER BUCKET MACHINE



FLEXIBLE SEWER-ROD EQUIPMENT CO.

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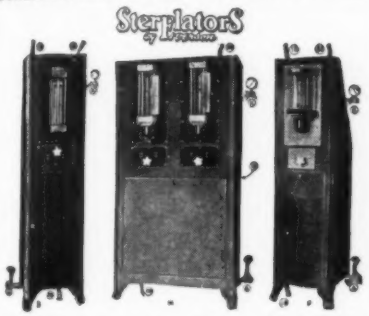

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Everson SterElators Operate Manually or Semi-Automatically, Also Automatically Proportion Gas Flow to Water Flow.

Everson SterElators Utilize a 24" Water Gauge Vacuum and Visible Flow Meters, with Wide Ratio Ranges of Capacities: 10 to 1, 50 to 1, 110 to 1.

All SterElators Are Dependable, Accurate, Safe and Easy to Operate. Guaranteed to Give Complete Satisfaction. NO JOB TOO LARGE

Send us Copy of Specifications

SterElators by Everson

EVERSON MFG. CORP.
233 W. Huron Street
Chicago 10, Ill., U. S. A.

Frank Bachmann to Florida for Dorr Co.

Frank Bachmann, member of the staff of the Dorr Co. for 28 years, has moved to Florida and will handle all sanitary engineering work for the company in that state (except the Western section). Mr. Bachmann's address will be P.O. Box 1962, Orlando, Florida.

Mr. Bachmann has traveled extensively for the Dorr Co. throughout the United States, Canada, Europe and the Far East. Before joining the Dorr staff in 1920 he had been a member of the staff of the Illinois State Water Survey, and later the Sanitary District of Chicago, and the California and Connecticut State Boards of Health.

No point in jointing cast iron water mains with HIGH PRICED LEAD!

Switch to

Haymanite
JOINTING COMPOUND

- Saves 75% of costs
- Goes 4 times as far
- Eliminates caulking
- Needs no large bell holes
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Once Haymanite is used for a bell and spigot cast iron water main installation, you'll never want to go back to lead or any other material. Aside from its tremendous cost-saving features, Haymanite is easily applied by any workman and requires fewer tools. Immediate shipment. FREE: Illustrated catalog.

Producers also of M. H. Brand Caulking Lead.

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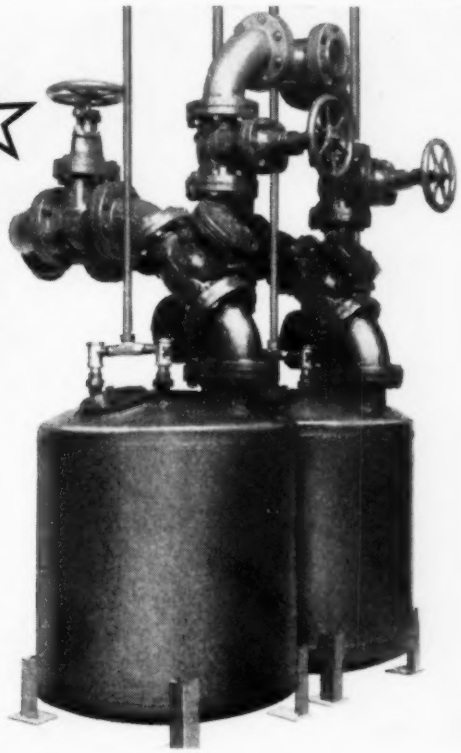
INCORPORATED
ESTABLISHED 1869
870 EAST FERRY ST., BUFFALO, N. Y.

CARTER
PNEUMATIC
SEWAGE
EJECTOR



It's easy to handle those troublesome small capacity sewage pumping problems if you specify a CARTER pneumatic sewage ejector.

You can forget the usual mechanical shredder or screen that you'd require for sewage pumps, because these ejector sets with their inherent ability to pass any solid or stringy material up to the diameter of the suction line cannot clog, because they operate with no moving parts.

Simplicity of design and efficiency of operation are but two of the important features you must consider for small capacity sewage pumping problems. Our literature gives complete details.

★ OTHER EQUIPMENT ·
MIXING · FLOCCULATION · DIGESTERS ·
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DIAPHRAGM PUMPS · PNEUMATIC EJECTORS

RALPH B. CARTER COMPANY
HACKENSACK, NEW JERSEY

1107

Le Roi Compressor

Le Roi Co., 1706 South 68th Street, Milwaukee 14, Wis., has announced a new versatile air compressor known as the H-540, a V-8, valve-in-head unit which provides extreme flexibility with speeds up to 1800 rpm.

This unit will run on gasoline, butane, or natural gas, and it can be adjusted to run on sewage sludge digestion gas, as well.

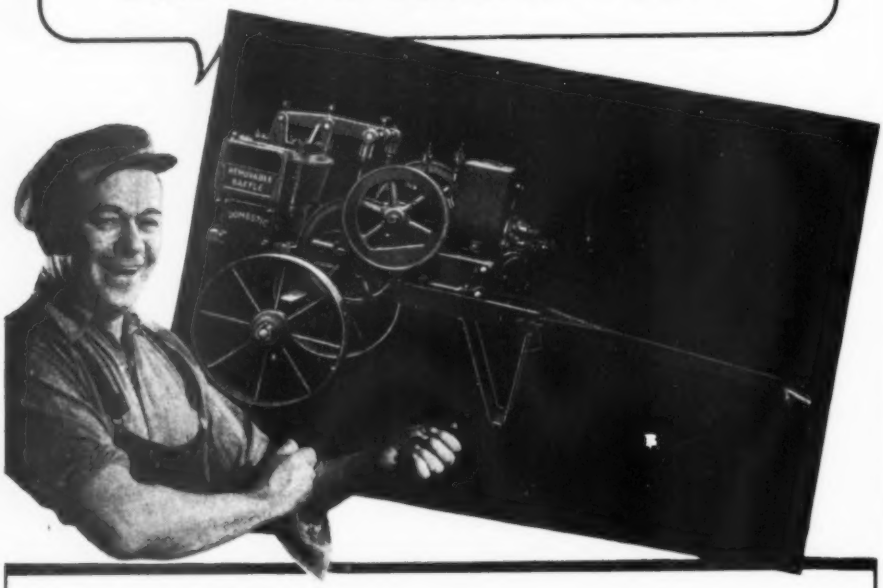
For further information on this new unit use a Reader Service Card on which is entered the above key number and your name and address.

Dr. Prutton Mathieson's Director of Research

Dr. Carl F. Prutton, formerly Head of the Department of Chemistry and Chemical Engineering at Case School of Applied Science, has joined Mathieson Chemical Corp. as Director of Research. He will have headquarters in Mathieson's executive offices in New York and at the research laboratories in Niagara Falls.

Dr. Prutton was a faculty member at Case from the time of his graduation from that school in 1920 until 1948. He was a consultant to the Lubrizol Corp. from 1928 until he joined Mathieson and a consultant to the Dow Chemical Co. from 1928 until 1941. From 1942 to 1944 he served as Chief of the Process Development Branch of the Office of Rubber Director and was also consultant to the War Production Board.

"WHEN CONFRONTED WITH SEEPAGE CALL FOR A 'DOMESTIC' PUMP!"



The combination of DOMESTIC diaphragm pumps and DOMESTIC engines results in efficient, low cost, dewatering of sewers, trenches, footings, foundations and similar applications.

"If it's a job for a pump- it's a job for Domestic"

For many years DOMESTIC engineering skill and "know how" have produced a line of pumps that brings satisfaction to their owners because of their operating efficiency, easy maintenance and adaptability.

Write to Dep't W for FREE catalog.

"DOMESTIC" ENGINE & PUMP COMPANY

A DIVISION OF EMPIRE INDUSTRIES, INC.
SHIPPENSBURG, PA., U. S. A.

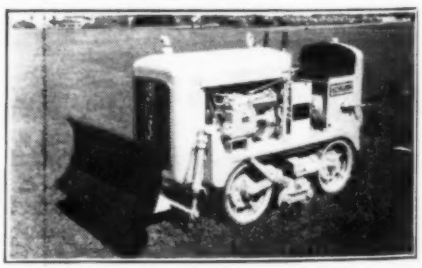
Peerless Pump Factory in Indianapolis

Peerless Pump Div. of Food Machinery Corp. has a new plant. This new Indianapolis, Ind., plant is the former Fall Creek Ordnance Works and was acquired from the War Assets Administration late in 1946 with a bid of $861,000. Construction features of the existing Fall Creek Plant are well adapted to the problem of setting up for high manufacturing volume of pump units.

1108

Crawler Compressor Backfiller

Schramm, Inc., West Chester, Penna., has announced a recent addition to the Schramm Model 60 Crawler Type Compressor. It is a hydraulically operated backfill blade.



The blade is operated by hydraulic pressure, supplied by a hydraulic pump. The pump is a self-contained unit with pressure relief valve, hydraulic reservoir and pump in one housing.

Two hydraulically operated cylinders, mounted on track guards, move the blade up and down, traveling 14 in. above ground level and 11 in.

below ground level. The blade is useful for backfilling ditches when used in conjunction with a pneumatic backfill tampar and can also be used for light grading around new developments.

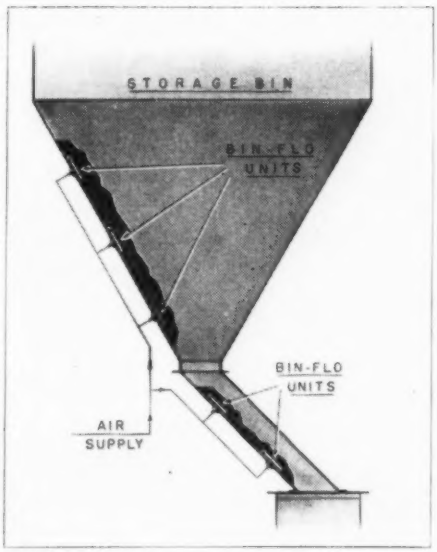
For further information on this item use a Reader Service Card on which is entered the above key number and your name and address.

J. A. Greenland DeLaval's Seattle Manager

Officials of the De Laval Steam Turbine Company have announced the appointment of J. A. Greenland as District Manager of the De Laval Seattle Office. Graduated from Rose Polytechnic Institute in 1938, Mr. Greenland joined the company in the same year, and was for some time associated with its main office in Trenton. He has been with the Seattle Office since May, 1940.

1109

Dry Feed from Bins



The Bin-Dicator Co., 14615 E. Jefferson Ave., Detroit 15, Mich., announces *Bin-Flo*, a new aerating device to provide uniform and steady flow of bulk materials from bins, hoppers, and chutes.

Bin-Flo provides a new and economical solution to the restriction and stoppage of bulk materials in bins and chutes. The Bin-Flo unit is a small plate which is readily located at points where flow is restricted. Low-pressure air is injected into the material through a special fabric diffuser, causing the material to flow freely. Bin-Flo units will not plug up even the most finely ground materials and are applicable to most dry, finely ground materials.

For further information, enter the above key number on a Reader Service Card and mail to this magazine.

Resinous Products Merges with Rohm & Haas

Announcement has been made of the merger of the Resinous Products and Chemical Co. of Philadelphia with the Rohm & Haas Co. The former company has pioneered in the development and manufacture of synthetic resins including the ion exchange material Amberlite. The latter manufactures insecticides among many other products.

"Every individual connected with water purification or sewage works should subscribe to this publication. I have introduced it to a host of friends in this field"*

Testimonials such as this from subscribers to WATER & SEWAGE WORKS really tell the story. The man who reads and uses the magazine as an aid in his work knows how much it will benefit other workers in the field.

If you are not a subscriber send your order today! The great REFERENCE & DATA issue alone is worth more than the yearly subscription rate.

**Name furnished on request.*

WATER & SEWAGE WORKS
22 West Maple Street
Chicago 10, Ill.

You may enter my order for ☐ 1 yr. @ $2.00 ☐ 2 yrs. @ $3.00 My title.....
Check enclosed ☐

Address.....

Send bill to..... City..... Zone..... State.....

The SEWER SCOOTER

(U. S. Patent 2,198,823)

THE ONLY 100% SELF-PROPELLING SEWER CLEANER

THE FLUSHING ACTION IS APPLIED BY COLLAPSING THE SHIELD.

A patented feature

No Preliminary Work—
Gets Results in a Hurry

SEWER SCOOTER MODEL A-3, BRONZE

Standard machines stocked 8 inches to 96 inches—For sale, rent or contract.

J. C. FITZGERALD

Box 289-A
Coral Gables 34, Fla.

FOR BETTER

pH Control

and **WATER TESTS**

there is nothing like

NON-FADING
GLASS COLOR
STANDARDS

Pocket
Comparator
No. 605

Permanent reliability of Hellige Glass Color Standards, accuracy of color comparison, simplicity of the technique, and compactness of the apparatus are exclusive features of Hellige Comparators not found in any similar outfits.

WRITE FOR BULLETIN No. 602

HELLIGE

INCORPORATED

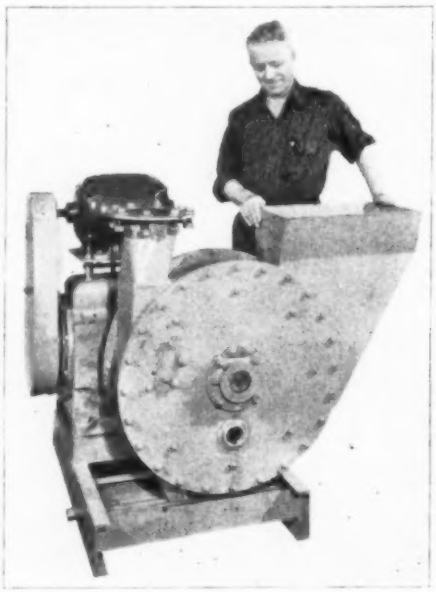
3718 NORTHERN BLVD. LONG ISLAND CITY 1, N.Y.

HEADQUARTERS FOR COLORIMETRIC APPARATUS

1110

Roto-Flo Pump

Roto-Flo Pump Corp., 249 North Water Street, Milwaukee 2, Wis., has developed a new style rotary pump



designed to handle any material which has viscosity that enables it to travel through a pipe.

The pump will transmit material either vertically or horizontally, and when the specific gravity and pipe friction are known, the pump can be engineered to meet varying conditions and materials. It is applicable to handling of fleshings in the tanning industry, pulp stock in the paper industry, paint and varnish ingredients, chemicals, food processing, and sludge in sewage treatment. It could also be used to handle the sludge from sedimentation basins, and softening plants in water supply.

For further information use a Reader Service Card on which is entered the above key number and your name and address.

1111

Flow Rate Kit

Brooks Rotameter Co., Lansdale, Penna., has developed a multi-range flow rate kit for research laboratories and pilot plants.

Nineteen liquid flow ranges are obtained with the unit, starting from a minimum of 0.1 ml. per min. to a maximum of 275 ml. per min. of water, or its equivalent in other liquids. If desired the liquid range can be extended to 0.4 gpm. Nineteen gas ranges are also provided.

For further information use a Reader Service Card on which is entered your name and address and the above key number.

APCO-V-APCO PRIMERS

AUTOMATIC POWER OR TANK PRIMERS

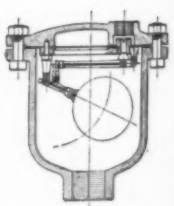
No. 2V-APCO

AIR RELEASE VALVES

FOR

FILTER PIPE LINES—DISTRIBUTION LINES
AND OTHER USES

17 TYPES



No. 200 VALVE

VALVE AND PRIMER CORPORATION 30 W. Washington St., Chicago 2, Ill.

CHEMCO
Equipment
FOR
EVERY CHLORINATION
AND
WATER CONDITIONING
PROBLEM

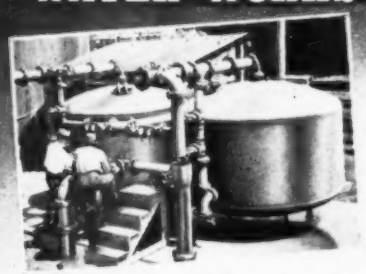
For Your
SEWAGE PLANT

CHEMCO CHLORINATORS are available for every type of installation. The above shows two CHEMCO 100# capacity chlorinator installed for the State of New York. Note use of Aqua-Thermal Coils.

For Your
SWIMMING
POOL

CHEMCO has "Everything for the Swimming Pool" from the Filters to the Life Preservers.

For Your
WATER WORKS



A large Chemco-Filter Plant installation for the Santa Fe Railroad, Winslow, Arizona. Consult CHEMCO first for your Chlorinator or Water Conditioning Problem.

CHEMICAL EQUIPMENT CO.
1700 NO. MAIN STREET
P. O. Box 3098 Terminal Annex
Los Angeles 54, Calif.
MIDWEST FACTORY BRANCH
205 W. Wacker Drive Chicago 6, Ill.
AGENTS IN PRINCIPAL CITIES

Chain Belt Opens Richmond Office

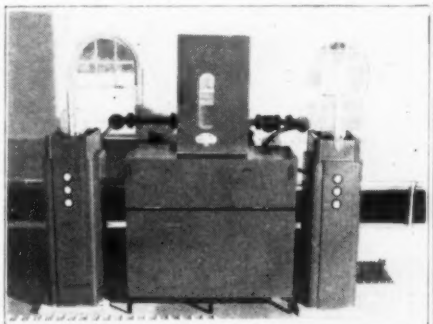
Chain Belt Co. has announced the opening of a new District Sales Office at 2900 West Clay Street, Richmond 21, Va. Mr. Fred W. Taylor will be District Manager of this office.

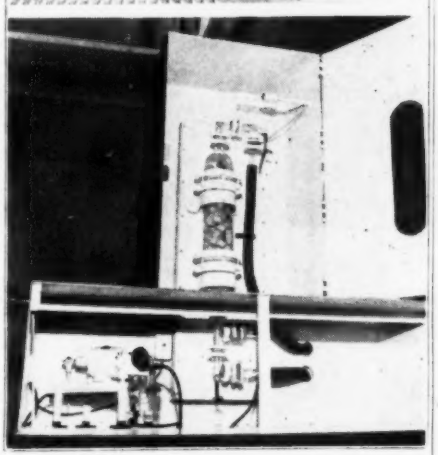
Mr. Taylor was with Chain Belt Co. from 1936 to 1946 as a Sales Engineer and later District Manager of the Atlanta District Office.

1112

Taste and Odor Control

Majax Co., Inc., 601 South First Street, Waco, Tex., has developed a unit for treating water to remove taste and odors. This new unit employs chlorine dioxide, and utilizes the Mathieson unit for making chlorine dioxide from sodium chlorite and chlorine. The sodium chlorite is pumped by means of one of the Majax Kem-Pumps.



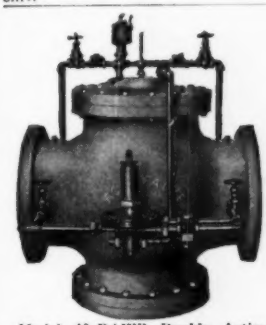


The accompanying illustration shows the details of the sodium chlorite-chlorine dioxide unit below, and the completely installed unit utilizing two Wallace & Tiernan chlorinators, above. This installation is at a municipal water plant in Texas.

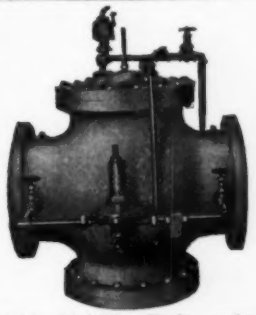
For further information on this unit use a Reader Service Card on which is entered the above key number and your name and address.

Est. 1879
ROSS
AUTOMATIC
VALVES

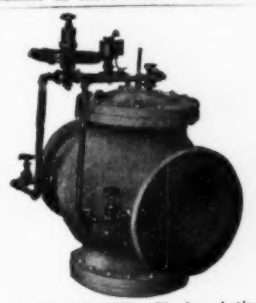
Altitude Valves for tank and reservoir, with two sets of controls—Automatic Hydraulic and Electric Remote Control. Hydraulic pilot normally operates the valve, while electric pilot is used for emergency only.



Model 40-DAWR Double Acting may be operated by electric pilot regardless of elevation of water in tank or reservoir, for a break in supply or distribution and when fire pressures require direct pumpage.



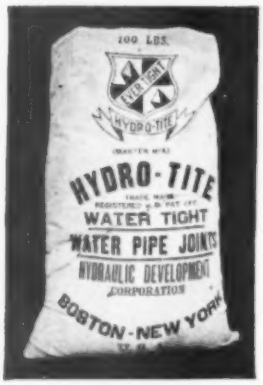
Model 30-AWR Single acting valve may be controlled in same manner as the Model 40-DAWR.



Model 40-AWR Single Acting semi-throttling valve will close on reversal of flow and the electric pilot would serve only a single purpose—either to open wide or close as emergency may require.

ROSS VALVE MFG. CO.
Incorporated
P.O. BOX 595, TROY, N.Y.

HYDRO-TITE



TESTED FOR OVER 30 YEARS

For more than thirty years water works superintendents have been using Hydro-tite for joining bell and spigot pipe. They have found that this self-caulking, self-sealing compound costs less to buy, requires less labor, makes tighter joints and withstands the effects of time, strain and vibration. Send for data book and sample.

ALWAYS USE FIBREX, the bacteria-free packing for pipe joints. Send for sample.

HYDRAULIC DEVELOPMENT CORPORATION
Main Sales Office: 50 Church St., New York, N.Y.
Works: West Medford Station, Boston, Mass.

LEADITE
The Pioneer Self-Caulking Material for C.I. Pipe

Time tried & Tested for over 50 Years

—Leadite is the Pioneer self-caulking jointing material for c.i. Bell & Spigot water pipe.

. . . Thousands of miles of pipe have been jointed with LEADITE—and Leadite not only saves *all along the line,* but it *improves* with age.

THE LEADITE COMPANY
Girard Trust Co. Bldg., Philadelphia 2, Pa.

No Caulking

LITERATURE AND CATALOGS

1113
WATER METER TESTING

The Ford Meter Box Company, Inc., Wabash, Ind., has a bulletin on **Water Meter Testing Equipment.** In this bulletin are articles on Testing Water Meters, Why Water Meters Should be Tested, The Importance of Testing at Proper Flow Rates, and Standard Specifications. Also included are features of Ford Testing Equipment, and selecting and installing equipment.

To obtain a copy of this bulletin, mail a Reader Service Card on which is entered the above key number and your name and address.

1114
RESINOUS ION EXCHANGERS

The Resinous Products & Chemical Co. of Philadelphia, Pa., publishes **The Resinous Reporter.** In the July, 1948, issue the entire issue of Volume 9, No. 4, was devoted to Ion Exchange. This 24-page book contains articles on the evolution of ion exchange resins, information on how the ion exchanger works, and data on three new Amberlite ion exchange resins.

Also contained in the booklet are articles on the operating capacity in relation to PH, Amberlite synthetic resin ion exchangers, mixed-bed deionization, and a glossary of ion exchange, as well as a bibliography on the subject.

To obtain a copy of this highly informative publication, use a Reader Service Card on which is entered your name and address.

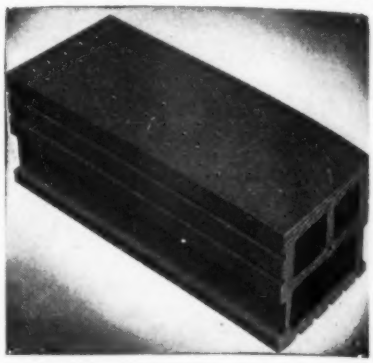
1115
HEATING AND MELTING

Hauck Mfg. Co., 124 Tenth St., Brooklyn 15, N. Y., has released Bulletin No. 1051 on **Heating and Melting Equipment** for Water Works, Sewer Depts., Public Utilities, Pipe Lines, and Contractors. Included in the catalog are Torch Flame Burner Equipment, Fire Guns, Weed Burners, Lead and Compound Melting Furnaces, Steam Thawers, Salamanders, Concrete Heaters, and Tar and Asphalt Melting Kettles.

To obtain a copy of this bulletin, mail a Reader Service Card on which is entered the above key number and your name and address.

Leopold

GLAZED FIRE CLAY TILE FILTER



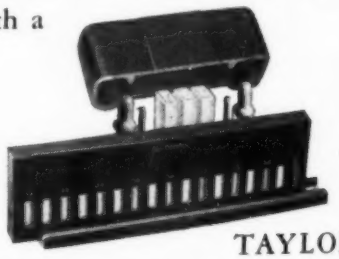
• Permanent •Non-corrosive • Economical • Impervious to acid or alkali solutions • Practically non-absorbent • Equal distribution.

Complete water purification and sewage plant equipment.

Write today for complete information

F. B. LEOPOLD CO., INC.
2413 W. CARSON ST. PITTSBURGH 4, PA.

ANYONE can make *QUICK • ACCURATE* Chlorine Determinations with a



TAYLOR-ENSLOW SLIDE COMPARATOR

The ideal instrument for determining the free or residual chlorine content of water, sewage, industrial wastes, etc.

Taylor-Enslow slides are molded of durable plastic and contain a set of 9 enclosed color standards. Two slides are available: 0.0 to 1.0 p.p.m. and 0.0 to 3.0 p.p.m. of chlorine. All Taylor liquid color standards carry an unlimited guarantee against fading. Combination pH and Chlorine sets, and complete Taylor Water Analyzer sets are also available. All sets are easily portable.

READ THIS INFORMATIVE BOOKLET

Write direct for "Modern pH and Chlorine Control" . . . gives valuable data for all water and sewage engineers . . . describes Taylor equipment. See your dealer for equipment.

W. A. TAYLOR AND CO.
7308 YORK RD. • BALTIMORE-4, MD.

1116

RUBBER PACKING GASKETS

Northrop & Co., Inc., Spring Valley, New York, has issued a leaflet on its new **Bond-O Rubber Packing Gaskets.** These gaskets are made for packing cast iron pipe joints, and are composed of flexible resilient rubber. Each size fits any class of pipe, and it is made in sizes for 4 to 14 in. pipe.

For a copy of this leaflet, use a Reader Service Card on which is entered the above key number and your name and address.

1117

SEWAGE SLUDGE UTILIZATION

The Royer Foundry & Machine Co., Kingston, Pa., has issued a composite bulletin titled **Sewage Sludge Utilization Catalog.**

This ring-binder book contains several bulletins and reprints, including bulletin 643 on "Profits from Sewage Sludge" by Royer; the Report of the Committee on Sewage Disposal of the A.P.H.A. on "Utilization of Sewage Sludge as a Fertilizer"; a list of Royer sludge disintegrator users; and several reprints of articles on the subject of sewage sludge as fertilizer, including several which have appeared in *Water & Sewage Works.*

If you desire a copy of this composite bulletin on the subject of Sewage Sludge Utilization, use a Reader Service Card on which is entered the above key number and your name and address.

1118

AIR VALVES

Multiplex Manufacturing Co., Berwick, Pa., has issued catalogue M on the **Crispin Air Valve.** This bulletin contains pictures, descriptions and data on the Crispin air and vacuum valve, pressure air valve, cluster valve, sewer valve, pressure turbine valve and many other valves for use in water and sewer lines where pressure or vacuum must either be maintained or broken.

To obtain a copy of this catalog on the "Crispin Air Valve," use a Reader Service Card on which is entered the above key number and your name and address.

1119

PIPE LINING

The Preload Corp., 420 Lexington Ave., New York 17, N. Y., has released a **Pipe Lining Bulletin** on Automatic Preload Pipe Lining. The bulletin shows how pipes were formerly cement lined by manually applied gunite, as compared with the modern method using the Automatic Preload Lining and Trowelling Machine. The bulletin also discusses the history, economics, and operation of the new method of pipe lining.

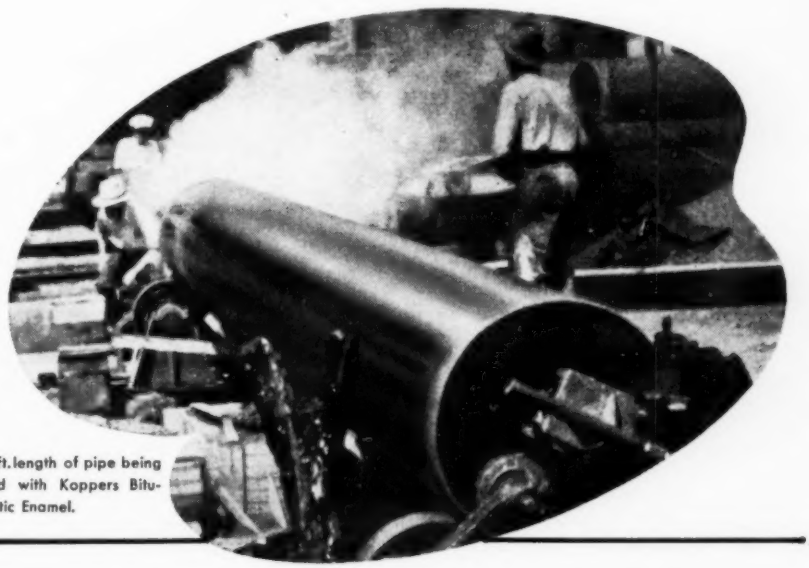
To obtain a copy of this bulletin, mail a Reader Service Card on which is entered the above key number and your name and address.

1120

METER MASTER

F. S. Brainard & Co., 246 Palm St., Hartford 5, Conn., has just issued a six-page folder, titled **Meet Meter Master.** In this folder appears a complete description of "The Rate Recorder for Water Meters" and tells how it works. Called the Waterworks G-Man, this 17-pound unit can be attached to any meter where it will give an accurate, complete, minute-to-minute recorded story of the actual use and waste of water.

To obtain a copy of this interesting folder, use a Reader Service Card on which is entered the above key number, and your name and address.



30-ft. length of pipe being lined with Koppers Bitumastic Enamel.

No perceptible change in this pipe's flow capacity after 16 years' service!

. . . another example of Bitumastic* protection.

In 1932, a 10-mile, 30-inch steel pipe-line was laid in Schuylkill County, Pa. by the Panther Valley Water Co., Lansford, Pa. Both interior and exterior were protected with Koppers Bitumastic Enamel.

Flow tests of this pipe-line—conducted over a period of 3 hours—gave coefficients of friction up to 145.8 (Williams & Hazen formula). Tests were again made after 8 years' continuous service, and the coefficients of friction varied between 145.5 and 151 . . . even better flow. And today, meter readings indicate that flow capacities are still equally high. The performance of Panther Valley's 16-year-old pipe-line is additional proof that Koppers Bitumastic Enamel provides long-lasting protection against corrosion, rust and tuberculation.

You can simplify your corrosion problems by writing our Contract Department. A complete protection service with trained supervision, skilled workmen and modern equipment is available on a contract basis.

KOPPERS

* Trade-Mark Reg. U. S. Pat. Off.

KOPPERS COMPANY, INC., DEPT. 1118T, PITTSBURGH 19, PA.

1121

PIPE, FITTINGS AND HYDRANTS

R. D. Wood Co., Public Ledger Bldg., Independence Square, Philadelphia 5, Pa., has just issued a new catalog on **C. I. Pipe and Fittings, Fire Hydrants, Gate Valves.** This 32-page catalog contains complete information on "Sand Spun Centrifugal Cast Iron 'Pipe'", "Matthews" Fire Hydrants, Gate Valves, Automatic Gas Producers, Hydraulic Machinery, Hydraulic Operating Valves, Meehanite Castings, and Centrifugally Cast Rolls.

To obtain a copy of this catalog, mail a Reader Service Card on which is entered the above key number and your name and address.

1122

CATHODIC PROTECTION

The Electro Rust-Proofing Corp., P. O. Box 178, Newark, N. J., has available a mailing piece on **Cathodic Protection** and how it works. This mailing piece contains a business reply card on which interested persons can request literature or other information. The piece also contains statements from a number of locations where the cathodic protection system is now being used.

To obtain this information enter the above key number and your name and address on a Reader Service Card and mail.

1123

CUTTING IN VALVE AND SLEEVE

The Eddy Valve Co., Waterford, N. Y., has published a four-page folder on the **Eddy Cutting In Valve and Sleeve.** This unit employs a mechanical joint and may be used with either the A.W.W.A. sand cast pipe in Classes H-B-C-D, or with Fed. Spec. W.W.P-421 centrifugal cast iron pipe in Classes 100-150-200-250.

The folder shows the unit in pictures and cross section, explains the simplicity of installation, and quotes from actual installation reports.

To obtain a copy of this folder, mail a Reader Service Card on which is entered the above key number and your name and address.

1124

TEXTBOOK ON DIESEL ENGINES

Hercules Motor Corporation, Canton, Ohio, has published a book titled **Hercules Diesel Engine—General Information.** This book contains information on the fundamentals of Diesel power and its advantages; construction of Hercules Diesel engine; the patented Hercules Combustion Chamber and a detailed description of how it functions; and the operation of the four cycle engine with functional charts and diagrams. It is not only a catalog of Hercules equipment which includes 2, 4, 6, and 8 cylinder high-speed, heavy-duty Diesel Engines, ranging from 12 to 400 horsepower, but it also contains much knowledge of Diesel Engine design and development which dates back to the early days of the Diesel.

If you are interested in Diesel Engines you will be interested in this book. To obtain a copy enter the above key number and your name and address on a Reader Service Card and mail.

1125

BIO-ACTIVATION

The American Well Works, Aurora, Ill., has a four-page folder on its **Bio-Activation Process.** The folder describes the process, shows an artist's drawing of its operation, and presents design factors.

To obtain a copy of this bulletin use a Reader Service Card on which is entered the above key number and your name and address.

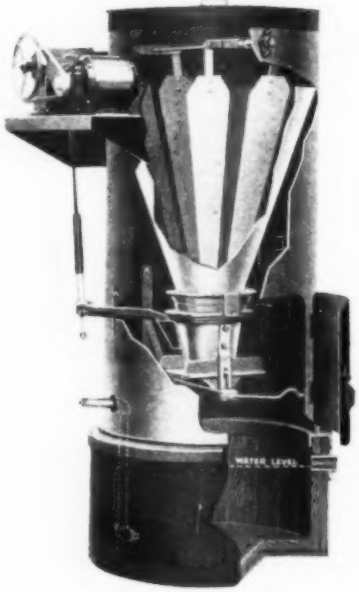
LET'S LOOK INSIDE

OMEGA

UNIVERSAL FEEDER

The simplicity of design and the rugged construction of the OMEGA Universal Feeder are apparent at a glance. Note the few working parts —nothing to get out of order. Special plate agitators eliminate arching or hanging of material in the hopper and the large openings and unique oscillating throat prevent clogging. The Universal handles lumps or fine powder, light or heavy material; it is ideal for feeding lime, soda ash, alum, ferric sulphate, etc., by volume. A simple micrometer screw adjusts the feeding rate over a 40 to 1 range. Feeding accuracy is maintained within 5% for most materials. Notice that the mechanism fits tightly on a large mixing chamber to make feeding dustproof. Extension hoppers and other auxiliary equipment available. The Universal is made in three sizes to feed from 1 to 5000 lbs. per hour.

Write for Bulletin 1-4.



OMEGA PRODUCTS

Volumetric Feeders • Gravimetric Feeders • Solution Feeders • Lime Slaking Equipment • Bucket Elevators Laboratory Stirrers

OMEGA MACHINE COMPANY

(Division of Builders Iron Foundry)

10 CODDING STREET • PROVIDENCE 1, R. I.

1126

FLOAT SWITCHES

The Automatic Control Co., St. Paul 4, Minn., has issued a single sheet bulletin No. 2050 describing float switches of the **LC-200** plus type and the **LC-200** flange type. Both are for closed tank operation for pressures up to 100 psi.

If you desire a copy of this bulletin enter the above key number and your name on a Reader Service Card.

1127

HOUSE CONNECTION PIPE

Johns-Manville, 22 E. 40th St., New York 16, N.Y., has a bulletin devoted to **Transite House Connection Pipe.**

This bulletin shows the construction of the pipe, gives five important advantages of transite house connection pipe, has a full page spread of typical installation layouts, gives dimensions of pipe and fittings, and shows how transite house connection pipe is quickly and easily installed.

To obtain a copy of this bulletin, enter the above key number on a Reader Service Card and mail.

1128

CLARIFIERS, ETC.

Hardinge Co., Inc., 240 Arch Street, York, Pa., has issued a new bulletin No. 35-C on Hardinge Clarifiers and other sanitation equipment.

This 12-page equipment bulletin gives a complete description and specifications of the Hardinge beam-type, circular clarifiers; center-column type, circular clarifiers; and a rectangular clarifier for skimming and sludge collecting. Also described are the Hardinge digesters, automatic backwash sand filters, flocculating equipment and the Ruggles-Coles rotary dryers.

To obtain a copy of this new bulletin use a Reader Service Card on which is entered the above key number and your name and address.

1129

VERTICAL TURBINE PUMPS

Layne & Bowler, Inc., Memphis, Tenn., has a large single sheet bulletin for folding into a regular three-ring notebook. The sheet describes the **Layne Water Lubricated Vertical Turbine Pumps.** A full length cutaway drawing and photograph are included together with information on pump head assemblies and bowl assemblies.

To obtain a copy of this sheet, mail a Reader Service Card on which is entered the above key number and your name and address.

• PRE-STRESSED "GUNITE" •

The picture shows a partially completed 40' diameter, 110,000 gallon pre-stressed "GUNITE" tank with a "GUNITE" dome roof, designed and built by us.

When this photo was made the tank was filled with water for leakage test. After the test showed the tank to be bottle-tight, two inch mesh reinforced "GUNITE" was placed over the outside to permanently protect the pre-stressed hoop rods. The tank was subsequently covered with earth, with 12" of fill over the dome.

This photo illustrates our method of pre-stressing the hoop rods by means of several turnbuckles in each hoop.

Before you build, repair or reinforce any structure of stone, brick, concrete or metal, discover the possibilities of "GUNITE". Write for full information today.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.

Faster
Stripping of
Meter Housings

When repainting of meter housings is necessary, depend on OAKITE STRIPPER M-3 for faster removal of old paint coats. This heavy-duty alkaline paint-stripper works through accumulations quickly and completely. For all the facts you need on solution-preparation and methods of application, check with the Oakite Technical Service Representative near you. Or write direct for full, free details, without obligation.

OAKITE PRODUCTS, INC.
73 Thames Street, NEW YORK 6, N. Y.
Technical Representatives in Principal Cities of U. S. & Canada

OAKITE
Specialized Industrial Cleaning
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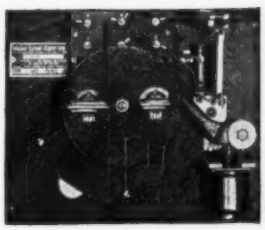

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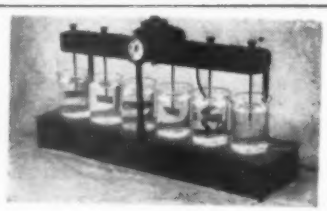

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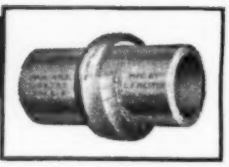

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CHEMICAL PUMP

The Milton Roy Co., 1300 E. Mermaid Ave., Chestnut Hill, Philadelphia 18, Pa., has reprinted Technical Paper No. 57 from **Chemical Engineering Progress,** Vol. 44, No. 4, April 1948. This paper is titled **Controlled Volume Chemical Pumps Design and Operation** and was authored by Robert T. Sheen, Consulting Engineer of the company.

To obtain a copy of this reprint, use a Reader Service Card on which is entered the above key number and your name and address.

1131

CORRECTIVE CHEMICAL FEEDING

The American Water Softener Co., Lehigh Ave. and Fourth Streets, Philadelphia, Pa., has published a bulletin on **"Corrective Chemical Feeding."** This bulletin which discusses the key to successful water refining, shows the American water softener chemical proportioner, and describes its operation for proportioning chemicals through a variable flow of water. It also discusses the multi-feeding of chemicals and other equipment including the non-clogging weir feed of chemicals.

If you desire a copy of this bulletin on the American Electro-Magnetic Proportioner and related equipment, use a Reader Service Card on which is entered the above key number and your name and address.

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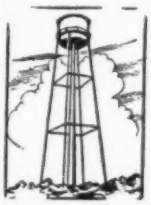

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1132

ZEO-KARB

Permutit Co., 330 W. 42nd St., New York 18, N.Y., has issued a very interesting bulletin on the "Decade of Progress, Permutit's **Zeo-Karb.**"

This pocket-size bulletin describes Zeo-Karb and its operation on the sodium cycle and the hydrogen cycle, and tells why it may be used for complete demineralization of water. Zeo-Karb is not a resin but is a carbonaceous cation exchanger.

A copy of this pocket-size bulletin with its information may be obtained by entering the above key number on a Reader Service Card.

1133

CHLORINATION TOPICS

Wallace & Tiernan Co., Inc., Newark, N. J., is again publishing its **Chlorination Topics.** These 4-page bulletins come out in two editions, Industrial, and Public Health. In the latter edition for August, short articles are presented on making check tests to insure best OTA test results, the technic for breakpoint control, differences between major types of chlorine residuals, etc. A column entitled "Who & What" by A. E. Griffin is in the lighter vein, and page 4 of **Chlorination Topics** contains abstracts of a number of articles concerned with the subjects of disinfection and operation of water and sewage plants and supply systems.

The industrial edition contains the same abstracts but includes short articles on chlorination of cooling water, bio-corrosion, de-sliming, etc.

If you desire a copy of these **Chlorination Topics** use a Reader Service Card on which is entered the above key number and your name and address.

1134

ELECTRODE GUIDE

Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., has published a new book as an **Electrode Guide.** This handy, compact guide presents all the facts pertaining to the most commonly used Airco electrodes, along with helpful data regarding the factors to be considered when choosing an electrode for a specific job. The booklet is profusely illustrated, 4 x 8 in. and thumb-indexed for ready reference.

If you desire a free copy of this pocket guide for Airco electrodes, fill in the Reader Service Card with your name, the above key number and mail to this magazine.

1135

INDUSTRIAL WASTE ABATEMENT

General Motors Corp., 3044 West Grand Blvd., Detroit 2, Mich., has published an article in its house organ **GM "Folks"** for August, 1948, on the subject of industrial waste pollution abatement.

This article, titled "First Aid For Fish," explains how laboratories of various plants of the General Motors Corp. are engaged in the testing of waste and the control of their treatment and discharge, to prevent stream pollution which would result in killing fish.

As examples of what is being done, mention is made of cyanide treatment in one plant, neutralization of pickling acids in another, elimination of oils from a third, and holding tanks to prevent "slugs" at another.

This is an interesting article on how a big corporation wisely and successfully attacks the problem of industrial waste pollution of streams.

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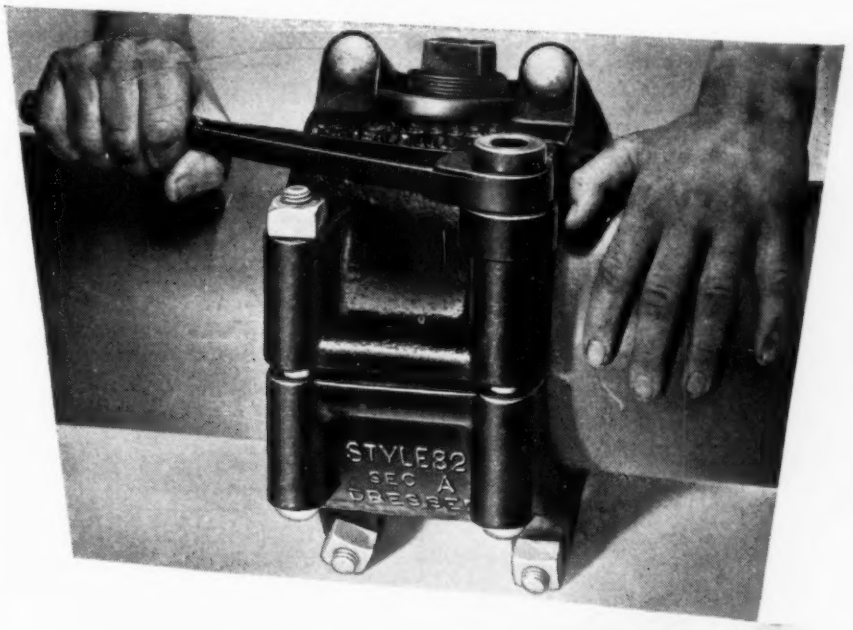

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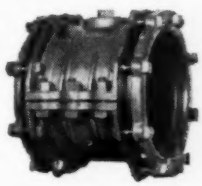

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INDEX TO ADVERTISERS

A

Alhydro, Inc. 95A
Allis-Chalmers 14A-15A
American Brass Company, The..... 16A
American Cast Iron Pipe Co..... 29A
*American Radiator & Standard Sanitary Corp 101A
*Anthracite Equipment Co..... 112A

B

Baker Adamson Products, General Chemical Div., Allied Chemical & Dye Corp. 34A
Badger Meter Mfg. Co..... 31A
*Bailey Meter Co..... 99A
Blaw-Knox Co. 93A
Bucyrus-Erie 88A
Buffalo Meter Co..... 97A
*Builders Iron Foundry..... 85A
*Builders-Providence, Inc. 85A
Byers Co., A. M..... 35A

C

Carborundum Co. 8A-9A
Carter Co., Ralph B..... 103A
Cast Iron Pipe Research Ass'n..... 6A-7A
Cement Gun Co..... 111A
Chemical Equipment Co..... 107A
Chicago Bridge & Iron Co..... 17A
*Chicago Pump Company..... 3A
*Cole Mfg. Co., R. D..... 36A
Clow & Sons, Jas. B..... 24A
Crane Co. 18A

D

Directory of Engineers..... 114A-115A
Dixie Tank & Bridge Co..... 26A
Domestic Engine & Pump Co..... 104A
Dorr Co. ..... Inside Back Cover
Dresser Mfg. Co..... 113A

E

Eddy Valve Co..... 24A
Edson Corporation, The..... 99A
Everson Mfg. Co..... 103A

F

Fairbanks-Morse 33A
*Fitzgerald, J. C..... 106A
*Flexible Sewer Rod Equipment Co. 102A
*Flexible Underground Pipe-Cleaning Co. 102A
Foster Co., L. B..... 93A

G

General Chemical Div. (Allied Chemical & Dye Corp.)..... 31A
*Golden-Anderson Valve Specialty Co. 91A

H

Hayman & Co., Michael..... 103A
Healy-Ruff Co. 111A
*Hellige, Inc. 106A
*Hooker Electrochemical Co..... 89A
Hydrauger Corp. 93A
Hydraulic Development Corp..... 108A

I

Industrial Chemical Sales..... 21A
*Infilco, Incorporated 86A
Iowa Valve Co..... 24A

J

Jeffrey Mfg. Co..... 10A
*Johns-Manville 23A

K

Koppers Co. 109A

L

Layne and Bowler, Inc..... 87A
Leadite Company 108A
*Leopold, F. B..... 108A
Lock Joint Pipe Co.....Inside Front Cover

M

*M. & H. Valve & Fitting Co..... 116A
Mathieson Chemical Corp..... 4A
Mathews Hydrants 12A
Meter Specialty Co..... 112A
Mueller Co. 32A

N

National Clay Pipe Mfrs.' Ass'n.... 25A
National Water Main Clean. Co..... 92A
Neptune Meter Company..... 36A
Northrop & Co., Inc..... 112A

O

Oakite Co. 111A
*Omega Machine Co..... 110A

P

Pacific Flush-Tank Company..... 27A
Peerless Pump Division..... 98A
Penna. Salt Mfg. Co..... 11A
Phipps & Bird, Inc..... 112A
Photovolt Corp. 93A
*Pittsburgh-Des Moines Steel Co.... 19A
Pittsburgh Pipe Cleaner Co..... 91A
Portland Cement Ass'n..... 22A
Presstite Engr. Co..... 96A
*Proportioners, Inc. 13A

R

Rensselaer Valve Co..... 101A
Roberts Filter Mfg. Co.....97A
Roots-Connersville Blower Corp..... 90A
*Ross Valve Mfg. Company..... 107A
Roy Co., Milton..... 89A
Royer Fdry. & Mach. Co..... 94A

S

Smith Mfg. Co., A. P..... 20A
Sonken-Galamba Corp. 112A
Speelmon Elevated Tank Service... 112A
Stuart Corp. 28A

T

Taylor & Co., W. A..... 108A
Thomson Meter Co..... 36A

U

*U. S. Pipe & Fdry. Co..... 29A
U. S. Tractor Co..... 30A

V

Valve & Primer Corp..... 106A
*Vapor Recovery Systems Co..... 100A

W

*Wallace & Tiernan Co., Inc...Back Cover
Warren Foundry & Pipe Corp..... 99A
Weston, L. A..... 112A
Wood Company, R. D..... 12A

Z

Zeolite Chemical Co..... 112A

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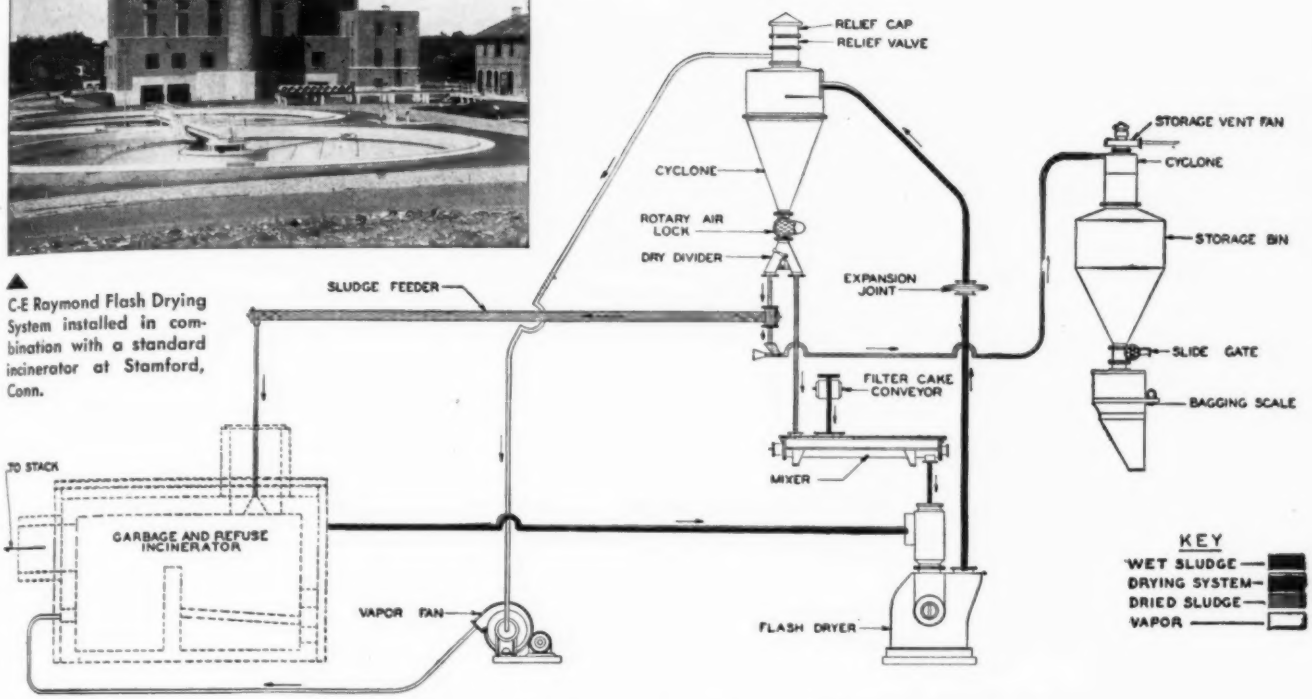

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Operating Flexibility Should fertilizer supply temporarily exceed demand, excess dried sludge can be burned in refuse incinerator.

Maximum Use of Heat Waste heat from the incinerator is used for drying in the C-E Raymond System, permitting all digester gas to be utilized for power generation.

Moderate Capital Investment Utilization of incinerator heat in the C-E Raymond System eliminates the need for a separate furnace and reduces first cost.

All inquiries on the C-E Raymond System should be directed to the nearest office of The Dorr Company, world sales representatives in the Sanitary Engineering Field.

In sewage treatment... there's a Dorr unit for practically every step in every flowsheet

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S-34